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SWATCH TEST RESULTS OF COMMERCIAL CHEMICAL PROTECTIVE GLOVES TO CHALLENGE BY CHEMICAL WARFARE AGENTS: SUMMARY REPORT

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Research and Technology Directorate

February 2001

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Swatches for eleven commercially available chemical protective gloves were challenged with liquid droplets of Sarin (GB) and mustard (HD) using modifications of the static diffusion procedure described in TOP 8-2-501. The cumulative mass of each agent that permeated each swatch was determined over time and the results for all swatches were used to determine an average cumulative mass for each glove. From these data, a breakthrough time was calculated for each glove/agent combination for the purposes of comparison.

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EXECUTIVE SUMMARY

As part of the Domestic Preparedness Program, eleven commercially available glove designs were tested to assess their capability to protect in a chemical warfare (CW) agent environment. Swatches of material from each glove design were tested for resistance to permeation for Sarin (GB) and mustard (HD). From this data, the author calculated the estimated time it would take to permeate the glove with sufficient agent to cause physiological effects in a person wearing the glove. The tests are described and the calculated breakthrough times are presented.

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PREFACE

The work described in this report was authorized under the Expert Assistance (Equipment Test) Program for the U.S. Army Soldier and Biological Chemical Command (SBCCOM) Program Director for Domestic Preparedness.

The use of either trade or manufacturers' names in this report does not constitute an official endorsement of any commercial products. This report may not be cited for purposes of advertisement.

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The author also acknowledges the technical contributions of the Expert Review Panel for Personal Protective Equipment (PPE) Testing as listed below:

Dr. Jimmy Perkins, University of Texas School of Public Health, San Antonio, TX.
Dr. Annetta Watson, Life Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN.
Dr. Ted Zellers, University of Michigan School of Public Health, Ann Arbor, MI.
Leo F. Saubier, Battelle Memorial Institute, Bel Air, MD.

The panel reviewed and commented on the test procedures, instrumentation, data analysis and presentation. Their guidance was a valuable element in the development of clear and adequate descriptions of the concepts and procedures used in these tests.

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TEST RESULTS OF COMMERCIAL CHEMICAL PROTECTIVE GLOVES TO CHALLENGE BY CHEMICAL WARFARE AGENTS: SUMMARY REPORT

1. INTRODUCTION

In 1996, Congress passed Public Law 104-201 (Defense Against Weapons of Mass Destruction Act of 1996), directing the Department of Defense (DoD) to assist other federal, state, and local agencies in enhancing their preparedness for terrorist attacks using weapons of mass destruction. The DoD responded by forming the Domestic Preparedness Program that same year. One of the objectives of the Domestic Preparedness Program is to enhance federal, state and local emergency and hazardous materials (HAZMAT) response to nuclear, biological and chemical (NBC) terrorism incidents. As part of an effective response, those emergency and HAZMAT personnel responding to an incident will use personal protective equipment (PPE) to protect them from exposure to chemical agents or biological agents. The specific PPE that would be used by these federal, state and local emergency and HAZMAT personnel would depend upon the situation encountered and the PPE held in inventory. In some cases, chemical protective gloves may be required to enter a contaminated or potentially contaminated area.

2. OBJECTIVES

This study evaluates some commercially available and commonly used chemical protective gloves to assess how well they resist vapor permeation from liquid contamination[1] by chemical agents Sarin (GB) and mustard (HD). This information is intended for federal, state and local emergency and HAZMAT personnel as an aid in their evaluation (and possible modification) of current work rules regarding specific chemical protective gloves currently in

[1] Throughout this report the term permeation is used even though for some of the tests the precise mechanism of agent transfer is not determined and penetration is possibly involved also.

inventory, and as an aid in future procurement of appropriate chemical protective gloves. This is especially important if these personnel choose to include military chemical and biological agent protection as a criterion. The information supplements data and information provided by the glove manufacturers. The gloves are tested in new, as-received condition. The effects of aging, temperature extremes, laundering, and other factors are beyond the intended scope of this test program. These tests are conducted to assess percutaneous (i.e. skin) protection only.

3. TESTING AND DATA ANALYSIS

3.1 Testing Overview

The chemical protective gloves that are tested in this test program are listed in Appendix A. Testing gloves includes a permeation test of material swatches to measure the permeation of both GB and HD through the swatches.

3.2 Liquid Challenge/Vapor Permeation Testing (Agent Swatch Testing)

3.2.1 Liquid Challenge/Vapor Permeation Testing Procedures

This testing is conducted to measure the vapor permeation of chemical agents GB and HD through glove swatches over a 24-hr period. The test is intended to assess how well the glove materials resist agent vapor permeation. The amount of agent applied and duration of exposure do not represent any particular threat that responders may encounter, but serve as a common point of reference for all test results.

The test methodology was taken from TOP 8-2-501[2] and is described in Appendix B. Twelve swatches were cut from three pairs of each glove design to be tested. Six of the twelve

[2] Test Operations Procedure (TOP) 8-2-501, Permeation and Penetration of Air-Permeable, Semipermeable and Impermeable Materials with Chemical Agents or Simulants (Swatch Testing). U.S. Army Dugway Proving Ground, UT. 3 March 1997, UNCLASSIFIED Report (AD A322329).

swatches were cut from the palm and six were cut from the cuff. Three of the palm swatches and three of the cuff swatches were allocated to GB testing and the remainder were allocated to HD testing. Swatches are taken from silicone (M45 military mask formulation) slabs for use as a source of HD or GB vapor, after contamination.

Laboratory personnel apply a predetermined liquid agent challenge of 10 g/m^2 to the top surface of each swatch.

The permeation apparatus contains seven test cells. For each test, swatches from one glove design were placed in six of the cells, palm and cuff swatches were placed in alternating cells, and a silicone swatch was placed in the seventh cell. Swatches were only taken from the palm (not the back) and the cuff. In the analysis, the palm swatch was assumed to represent the palm, fingers and back of the hand and the cuff was assumed to represent the remainder of the glove that covers the wrist and forearm area.

Agent droplets (1 µl) are applied to the surface of the first swatch at time zero. Agent is then applied to the surface of each succeeding swatch at 3-min intervals. The upper chamber of each test cell is sealed. A 1.0 L/min flow of temperature- and humidity-controlled fresh air was supplied to the lower test cell chamber beneath each swatch.

During the 24-hr test period, gas samples are taken on a sequential basis from the airstream beneath each swatch by a laboratory MINICAMS™ with stream selection system (a miniaturized gas chromatograph with flame photometric detector and sampling system (OI Analytical, CMS Field Products Group, Birmingham, AL)). Gas sampling by the MINICAMS™ begins for the first swatch approximately 3 min following agent application. Subsequent 3-min cycles of the MINICAMS™ are composed of 2 min of desorption of collected agent vapor from

the pre-concentrator tube (PCT) onto the column followed by 1 min of gas sampling (collection of agent vapor in the PCT). Sampling is sequential through the six glove material swatches, the silicone swatch[3], and three blank gas samples (taken from the test cabinet to purge the sampling line before repeating the sampling sequence). The six glove material swatches, the silicone swatch, and three blanks are all sampled for the first time within the first 30 min of the test. Then the sampling sequence begins anew.

The MINICAMS^{TM} first determines the amount of agent vapor in each gas sample. Using this result, the amount (ng) of agent vapor present in the airstream that passes beneath the swatch over the time from the previous gas sample to the current gas sample is determined by the MINICAMS^{TM} permeation software. The calculations assume that the permeation change with time is a straight line over the 30-min interval. The permeation for each time interval is the average of the permeation rates (flux, ng/cm^2 /min) for the current and the previous gas samples multiplied by 30 min. This amount of agent vapor is presumed to be the amount of agent vapor that has permeated the swatch over that time interval. The cumulative mass of agent permeating the swatch per unit area at any elapsed time during the 24-hr test is defined as M_f. It is based on the mass permeated in the time interval over the effective swatch area, which is the opening in the permeation cell (10 cm^2), and is determined by the MINICAMS^{TM} permeation software. Over the 24-hr test period, a series of M_f values is calculated for each swatch.

[3] Originally, it was intended to use silicone swatches as references or controls, but it was soon found that permeation through the silicone varies too widely for it to be used for that purpose. Silicone swatches were used anyway, because they serve as a reliable source of agent vapor to assure the tester that the MINICAMS(r) is responding properly during tests when little or no agent permeates the actual test swatches.
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3.2.2 Liquid Challenge/Vapor Permeation Testing Analysis

Each glove has M_f data for 6 swatches for each of the two agents over the 24-hr test period. The M_f data are taken for each of the three swatches from one sampling area tested with one of the agents. For this report, the average (of three swatches) cumulative permeation (M_f) is calculated. This average is then presented, at each of the reported elapsed times, as representative of the glove's permeation resistance at that sampling area. The reported elapsed time for each sampling area is the sum of the elapsed times for the three swatches divided by three.

To estimate M_f at each elapsed time for a glove, the simplifying assumption is that the exposure is uniform over the entire glove. This permits the determination of an average M_f at each average elapsed time. The average elapsed time is the sum of the reported elapsed times for both sampling areas divided by two. The surface areas were assumed to be 0.5 for the cuff area and 0.5 for the palm area. Swatches were taken from approximately the same locations for all gloves; from the center of the palm and from the cuff area near the end of the glove. The average M_f at any average elapsed time is calculated using the following equation:

$$\text{Average } M_f = 0.5(\text{palm material } M_f) + 0.5(\text{cuff material } M_f) \qquad \textit{Equation 1}$$

3.2.3 Relationship Between Liquid Challenge/Vapor Permeation Test Results and Skin Exposure

The permeation test is designed to distinguish among these material swatches according to their permeation resistance to chemical agents. It is not intended to specifically replicate threat scenarios that may be encountered in actual use. As previously reported by

Belmonte[4], it is instructive to estimate the agent dosage ($C_i t_{skin}$) that would result from such a standard agent challenge as a relative indication of possible physiological effects. This is done by converting the weighted average M_fs to equivalent agent dosages. This relationship was developed by Fedele (written communication, Dr. P. Fedele, R&T Directorate, ERDEC, July 1997) and was reported by Belmonte[4]. For glove materials impermeable to airflow, the only mechanism for removal of agent vapor that permeates the barrier is assumed to be its permeation through the skin, so the equation is:

$$\text{Agent Dosage } (\text{mg - min/m}^3) = \frac{M_f \ (\text{ng/cm}^2)}{\text{Permeability of skin to agent vapor (cm/min)}} \qquad \textbf{\textit{Equation 2}}$$

where skin permeability is 2 cm/min for HD and 0.1 cm/min for GB. The agent dosage can then be compared to doses that are known to cause certain levels of toxicity. It is assumed that skin permeation of HD and GB are roughly equivalent over the entire body.

3.2.4 Evaluation Criteria for Liquid Challenge/Vapor Permeation Test Results

When analyzing the test results, it is useful to determine whether the data indicate that the chemical protective glove provides percutaneous protection over some period of time. Mustard vapor can produce erythema (reddening of the skin) at dosages of approximately 1039 mg-min/m^3 on the backs of the hands. It can produce vesication (skin burns and blisters) at 2078 mg-min/m^3 on the backs of the hands. It was assumed that the hands were protected by the test gloves and challenged uniformly by the liquid dose used on the swatches. Using the threshold

[4] Test Results of Level A Suits to Challenge by Chemical and Biological Warfare Agents and Simulants: Summary Report. U. S. Army Edgewood Research Development and Engineering Center, MD. August 1998, UNCLASSIFIED Report (AD A353013).

skin reddening dosage, and the skin permeability for mustard and substituting values in Equation 2, we obtain the HD threshold value for M_f

$$\text{Threshold } M_f = 2 \text{ X } 1039 = 2078 \text{ ng/cm}^2 \qquad \textbf{\textit{Equation 3}}$$

Sarin vapor can produce incapacitation at percutaneous dosages of approximately 8000 mg-min/m^3 and can cause lethality at dosages of 15000 mg-min/m^3 where exposed persons are healthy, young, fit, and well-nourished males of approximately 70-kg mass. People who are smaller, less fit, etc., may exhibit adverse effects at lower doses ($C_i t_{skin}$). Unlike mustard, Sarin acts systemically: the body reacts to the total amount of Sarin absorbed by the body. For this analysis it was assumed that the gloves are incorporated into a full ensemble protecting the entire body, but that only the gloves are challenged by liquid agent. The amount of Sarin agent per unit area (average M_f) necessary to permeate glove material covering the hands and forearms and produce a predetermined systemic effect was estimated by using the whole body dosage threshold of incapacitation (8000 mg-min/m^3), the skin permeability to Sarin agent (0.1 cm/min) from Equation 2 and 8.41% as the fractional area (proportion of the total body area represented by the hands and forearms in the BRHA model[5]). The relationship is:

$$\text{Threshold } M_f = (\text{Threshold dose X skin permeability})/(\text{fractional area}) \qquad \textbf{\textit{Equation 4}}$$

Substituting,

$$M_f = (8000\text{x}0.1)/(0.0841) = 9{,}512 \text{ ng/cm}^2 \qquad \textbf{\textit{Equation 5}}$$

[5] Fedele, Dr. Paul D., Nelson, Douglas, C., *A Method of Assessing Full Individual Protective System Performance Against Cutaneous Effects of Aerosol and Vapor Exposures*, U.S. Army Edgewood Research, Development and Engineering Center, Aberdeen Proving Ground, Maryland, October, 1995; Section 1-3 "Body Region Hazard Analysis Process" included in the report for the JSLIST Program: Cronin, Tracy D., *Final Report for the Development of the Man-In-Simulant Test (MIST) Methodology for Evaluation of Chemical/Biological (CB) Protective Garments*, TECOM Project No. 8-EI-825-ABO-004, U.S. Army Dugway Proving Ground, Dugway, Utah, April 1996.

This value is used in the graphs of average M_f versus time and is summarized in Table 1. The breakthrough time is the time at which the average M_f reaches the GB threshold value for M_f.

Table 1. Agent Breakthrough Criteria

Agent	Threshold Dosage (mg-min/m^3)	Physiological Effect	Skin Permeability (P_s), (cm/min)	Threshold M_f (ng/cm^2)
HD	1039	Erythema	2	2078
HD	2078	Vesication	2	4156
GB	8000	Incapacitation	0.1	9512
GB	15000	Lethality	0.1	17,836

Breakthrough time should not be interpreted as the time that a glove can be safely worn, either for HD or GB. The effect of closure and seam failure was not considered. Breakthrough times should only be used to compare glove materials.

ACRONYMS and ABBREVIATIONS

Ct	Vapor exposure, product of vapor concentration (mg/m^3) and time (minutes)
$C_I t_{skin}$	Vapor exposure to skin
cm^2	Square centimeters
°F	Temperature in degrees Fahrenheit
delta p	Differential pressure
DoD	Department of Defense
ECBC	U.S. Army Edgewood Chemical Biological Center
ERDEC	U.S. Army Edgewood Research, Development and Engineering Center
g	Gram
GB	Sarin, Isopropylmethylphosphonofluoridate
HD	Sulfur Mustard; 2,2'-Dichlorodiethylsulfide
L	Liter
M_f	Cumulative mass permeation through the material
m^2	Square meters
m^3	Cubic meters
mg	Milligram
µL	Microliter
ng	Nanogram
NBC	Nuclear, Biological and Chemical
PCT	Pre-concentrator tube
PPE	Personal Protective Equipment
P_s	Skin permeability
RH	Relative Humidity
TOP	Test Operations Procedure

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Appendix A -
Gloves Chosen for Testing

Table A- 1. Gloves Tested

Model	Manufacturer	Address
Best Butyl 878-10, 30 mil	Best Manufacturing Co.	Menlo, GA
Ansell-Edmont Thermaprene, 9-024	Ansell Edmont	Coshocton, OH
Bayside Latex Examination Glove	Bayside Glove Co.	Baltimore, MD
Safety Zone Gloves, GL1-NPFL	Gann Safety Supply	Baltimore, MD
MAPA Neoprene, PN1-N450	Gann Safety Supply	Baltimore, MD
Ansell Edmont TNT Nitrile, 92-500	Ansell Edmont	Coshocton, OH
Ansell Edmont PVA, 15-554	Ansell Edmont	Coshocton, OH
Hahn Fat, PVC, GL1-VC7714R	Gann Safety Supply	Baltimore, MD
Safety 4H Glove	Safety 4 Inc.	Lenexa, KS
Ansell Edmont Sol-Vex, 37-155	Ansell Edmont	Coshocton, OH
Best Viton 890-10, 30 mil	Best Manufacturing Co.	Menlo, GA

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Appendix B -
Modified Static Diffusion Test Procedure

MODIFIED STATIC DIFFUSION TEST

This test procedure was adapted from Test Operations Procedure (TOP) 8-2-501, Permeation and Penetration of Air-Permeable, Semipermeable and Impermeable Materials with Chemical Agents or Simulants (Swatch Testing). U.S. Army Dugway Proving Ground, UT. 3 March 1997, UNCLASSIFIED Report (AD A322329).

The following procedure was used**:**

1.Upon receipt of the gloves, all available information concerning the gloves will be recorded; date of manufacture, lot number, serial number, materials of construction, etc.

2. From each pair of gloves, one each 1 and 15/16 in diameter material swatch will be taken from the cuff area for HD and one like-sized material swatch will be taken from the cuff area for GB. From the same pair of gloves, one each 1 and 15/16 in diameter material swatch will be taken from the palm area for HD and one like-sized material swatch will be taken from the palm area for GB. Swatches will be taken from at least 3 pairs of gloves (a minimum of 6 HD swatches and 6 GB swatches will be tested) for each glove model/style. Thickness measurements will be taken and recorded for each swatch. Each swatch will be placed in an airtight bag and given a unique serial number, which will be placed on the bag. A list of serial numbers will be kept with the swatches.

3. The environmental chamber will be controlled at a temperature of 90 +/- 2 °F (32.2 +/- 1 °C) and the maximum achievable relative humidity without occurrence of condensation (60% +/- 10% RH). The temperature and RH readings will be checked weekly with a calibrated meter. The test cell air will be

drawn from the chamber air. TOP 8-2-501 specifies that a system control and data acquisition system will be used but this system was not used due to budget constraints. The temperature and RH will be recorded in a computer file. Flow rates will be manually recorded. TOP 8-2-501 specifies that differential pressure monitoring will be done but differential pressure gages were not used due to budget constraints.

4. The TOP test cell will be used. When assembling, the cell lugs will be tightened by hand to finger tight. The flow rate beneath each swatch will be 1 L/min, which will be controlled by a linear mass flow controller. The flows will be checked with a calibrated test meter weekly. Each test cell will be checked for leaks after assembly by connecting it to the vacuum source and checking that the inlet flow is the same as the outlet flow on the mass flow controller (cell lugs will be retightened if flows don't match).

5. The swatches will be preconditioned overnight in the environmental chamber. Eighty-mil silicone will be used as an indicator swatch to verify that the MINICAMS can detect agent vapor permeation (one silicone swatch per 6 glove swatches). TOP 8-2-501 specifies that positive control and negative control swatches will be used but they were not used due to budgetary and schedule limitations.

6. Agents GB and HD will be used. The contamination density will be 10 g/m^2 (eight 1 µL HD droplets or ten 1 µL GB droplets). The agent will be applied using the click/touch method with a Hamilton repeating dispenser. TOP 8-2-501 specifies that a robotic agent application system will be used for agent application but this was not done due to budget constraints.

7. Seven swatches will be tested at once. MINICAMS with stream selection system will monitor vapor permeation with a 3-min cycle per swatch. There will be 3 blank sampling intervals following the indicator swatch. Each swatch will be sampled once every 30 min. The MINICAMS will be standardized weekly.

8. The test length will be 24 hr.

9. The test cells and o-rings will be aerated between uses. No other cleaning method will be used.

10. The data to be reported are cumulative permeation (ng/cm^2) versus elapsed time from contamination (min) for each swatch. All recorded data will be placed in laboratory notebooks and a technical report will be drafted at the conclusion of this effort.

APPENDIX B

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Appendix C -

BEST BUTYL

Figure C- 1: Best Butyl Glove

Table C- 1. Best Butyl Glove - Average HD Permeation

Best Butyl Glove (878-10)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
5	6	14	10	9	8
35	61	44	42	39	52
65	79	74	58	69	68
95	94	104	70	100	82
125	110	134	81	130	95
155	130	164	94	160	112
186	156	195	110	190	133
216	186	225	128	220	157
246	221	255	150	250	185
276	259	285	175	281	217
306	300	315	200	311	250
336	342	345	224	341	283
367	383	376	250	371	317
397	425	406	276	401	350
427	469	436	305	431	387
457	516	466	339	462	427
487	566	496	377	492	471
517	621	526	421	522	521
548	685	557	477	552	581
578	761	587	549	582	655
608	854	617	639	612	747
638	966	647	755	643	861
668	1105	677	900	673	1002
698	1273	707	1076	703	1174
729	1469	738	1287	733	1378
759	1701	768	1533	763	1617
789	1974	798	1823	793	1898
819	2290	828	2159	824	2225
849	2652	858	2536	854	2594
879	3058	888	2961	884	3010
910	3516	919	3437	914	3477
940	4027	949	3963	944	3995
970	4590	979	4537	974	4563
1000	5200	1009	5158	1005	5179
1030	5866	1039	5821	1035	5844
1060	6587	1069	6531	1065	6559
1091	7346	1100	7304	1095	7325
1121	8155	1130	8128	1125	8141
1151	9020	1160	8982	1155	9001
1181	9934	1190	9870	1186	9902
1211	10889	1220	10800	1216	10844
1241	11880	1250	11779	1246	11829
1272	12909	1281	12791	1276	12850
1302	13973	1311	13831	1306	13902
1332	15069	1341	14918	1336	14993
1362	16186	1371	16020	1367	16103
1392	17325	1401	17127	1397	17226
1422	18482	1431	18263	1427	18373

Table C- 2. Best Butyl Glove - Average GB Permeation

Best Butyl Glove (878-10)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
7	1	10	1	9	1
37	10	40	12	39	11
67	23	70	27	69	25
97	39	100	44	99	41
127	56	130	61	129	59
157	73	160	78	159	76
187	90	190	95	189	92
217	106	220	110	219	108
247	121	250	124	249	123
277	134	280	137	279	136
307	146	310	149	309	148
337	157	340	159	339	158
367	166	370	169	369	168
397	175	400	177	399	176
427	184	430	185	429	184
457	191	460	193	459	192
487	198	490	199	489	199
517	205	520	206	519	205
547	212	550	212	549	212
577	218	580	218	579	218
607	224	610	223	609	223
637	229	640	229	639	229
667	234	670	234	669	234
697	240	700	238	699	239
727	245	730	243	729	244
757	249	760	247	759	248
787	254	790	252	789	253
817	259	820	256	819	257
847	263	850	260	849	261
877	268	880	264	879	266
907	272	910	267	909	270
937	276	940	271	939	274
967	280	970	275	969	277
997	284	1000	278	999	281
1027	289	1030	282	1029	285
1057	293	1060	285	1059	289
1087	297	1090	288	1089	292
1117	301	1120	291	1119	296
1147	305	1150	295	1149	300
1177	309	1180	298	1179	303
1207	313	1210	301	1209	307
1237	317	1240	304	1239	310
1267	321	1270	307	1269	314
1297	325	1300	310	1299	317
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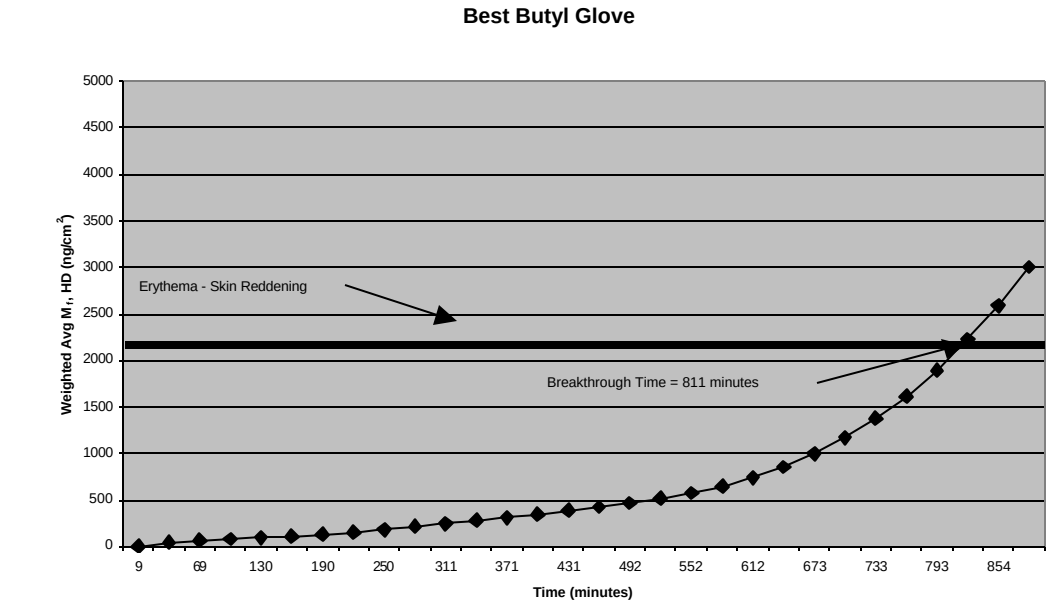

Figure C- 2: Best Butyl Glove - Average HD Cumulative Permeation

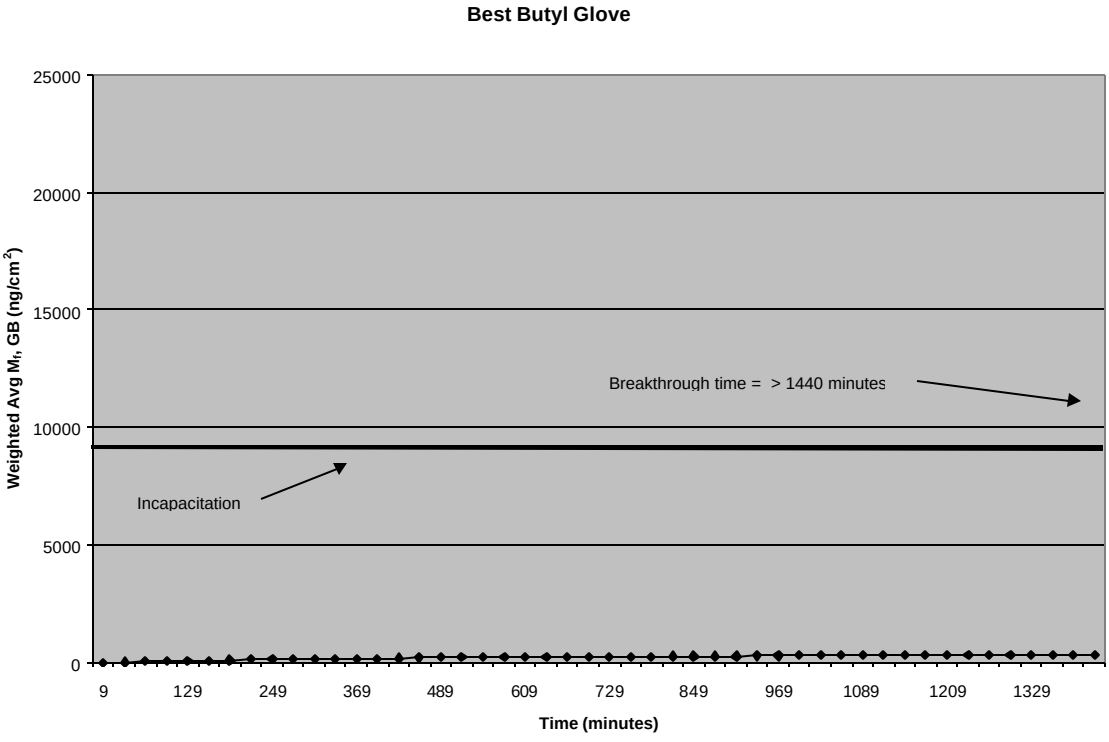

Figure C- 3: Best Butyl Glove - Average GB Cumulative Permeation

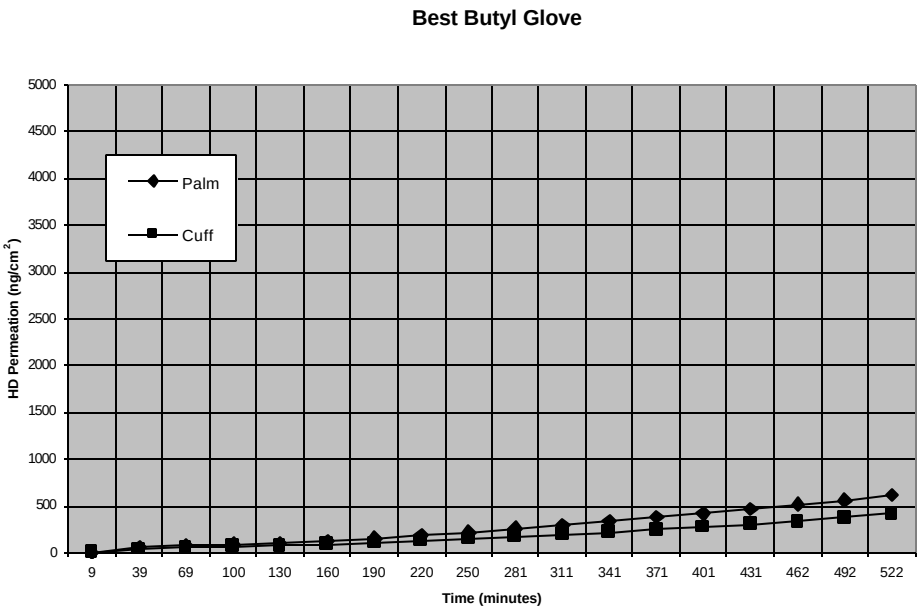

Figure C- 4: Best Butyl Glove: HD Cumulative Permeation by Sampling Area

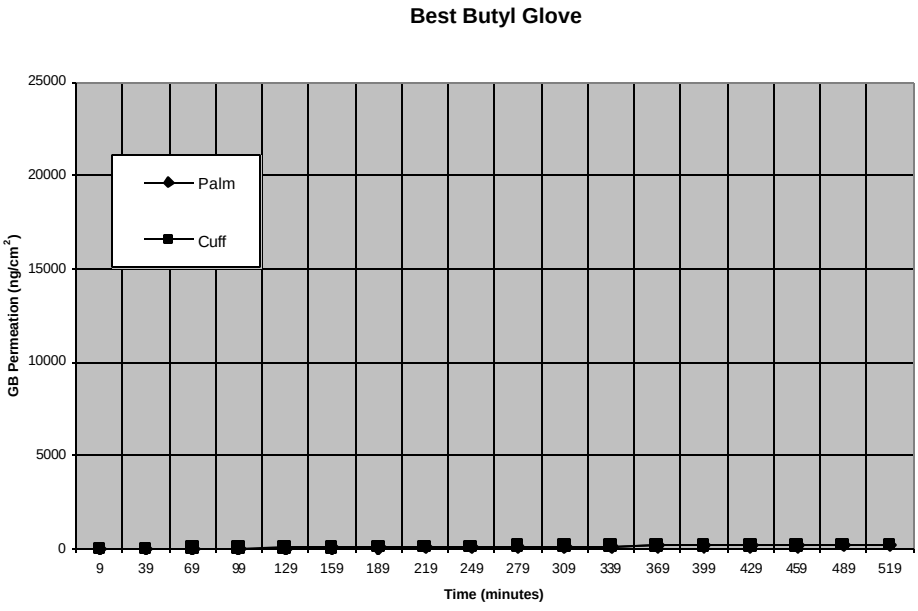

Figure C- 5: Best Butyl Glove: GB Cumulative Permeation by Sampling Area

Appendix D -

ANSELL EDMONT THERMAPRENE

Figure D- 1: Ansell Edmont Thermaprene Glove

Table D- 1. Ansell Edmont Thermaprene Glove - Average HD Permeation

Ansell Edmont Thermaprene Glove (9-024)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
5	3	14	11	10	7
35	36	44	522	40	279
65	73	74	1668	70	871
95	187	104	2983	100	1585
125	430	134	4297	130	2364
155	778	164	5606	160	3192
185	1225	194	6719	190	3972
215	1827	224	7834	220	4831
245	2644	254	9081	250	5863
275	3691	284	10329	280	7010
305	4891	314	11639	310	8265
335	6168	344	12950	340	9559
365	7495	374	14266	370	10881
395	8833	404	15582	400	12208
425	10172	434	16898	430	13535
455	11513	464	18217	460	14865
485	12855	494	19537	490	16196
515	14192	524	20854	520	17523
545	15523	554	22169	550	18846
575	16855	584	23481	580	20168
605	18189	614	24793	610	21491
635	19543	644	26123	640	22833
665	20928	674	27477	670	24203
695	22329	704	28839	700	25584
725	23730	734	30200	730	26965
755	25131	764	31562	760	28347
785	26537	794	32928	790	29733
815	27946	824	34299	820	31123
845	29361	854	35675	850	32518
875	30781	884	37051	880	33916
905	32202	914	38424	910	35313
935	33616	944	39807	940	36712
965	35030	974	41202	970	38116
995	36448	1004	42599	1000	39524
1025	37864	1034	43997	1030	40931
1055	39278	1064	45391	1060	42335
1085	40694	1094	46780	1090	43737
1115	42108	1124	48170	1120	45139
1145	43519	1154	49564	1150	46542
1175	44937	1184	50962	1180	47950
1205	46358	1214	52353	1210	49356
1235	47778	1244	53733	1240	50756
1265	49193	1274	55114	1270	52154
1295	50808	1304	56696	1300	53752
1325	52626	1334	58477	1330	55552
1355	54461	1364	60285	1360	57373
1385	56267	1394	62016	1390	59142
1415	57966	1424	63633	1420	60800

Table D- 2. Ansell Edmont Thermaprene Glove - Average GB Permeation

Ansell Edmont Thermaprene Glove (9-024)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
9	19	12	26	10	22
39	135	42	150	40	142
69	255	72	413	70	334
99	411	102	1456	100	933
129	625	132	3586	130	2105
159	873	162	6296	160	3585
189	1124	192	9099	190	5112
219	1357	222	11738	220	6547
249	1566	252	14103	250	7835
279	1751	282	16136	280	8944
309	1915	312	17846	310	9880
339	2060	342	19272	340	10666
369	2189	372	20446	370	11317
399	2303	402	21405	400	11854
429	2402	432	22171	430	12287
459	2491	462	22785	460	12638
489	2570	492	23278	490	12924
519	2642	522	23668	520	13155
549	2708	552	23978	550	13343
579	2767	582	24230	580	13498
609	2822	612	24435	610	13628
639	2873	642	24606	640	13740
669	2921	672	24754	670	13837
699	2966	702	24883	700	13925
729	3010	732	24997	730	14003
759	3052	762	25097	760	14074
789	3090	792	25187	790	14138
819	3127	822	25267	820	14197
849	3163	852	25341	850	14252
879	3197	882	25409	880	14303
909	3230	912	25471	910	14350
939	3262	942	25528	940	14395
969	3293	972	25582	970	14437
999	3322	1002	25632	1000	14477
1029	3354	1032	25682	1030	14518
1059	3388	1062	25735	1060	14561
1089	3422	1092	25787	1090	14604
1119	3455	1122	25836	1120	14646
1149	3488	1152	25882	1150	14685
1179	3519	1182	25927	1180	14723
1209	3549	1212	25968	1210	14759
1239	3578	1242	26008	1240	14793
1269	3607	1272	26046	1270	14827
1299	3635	1302	26083	1300	14859
1329	3661	1332	26119	1330	14890
1359	3687	1362	26154	1360	14921
1389	3713	1392	26187	1390	14950
1419	3738	1422	26220	1420	14979

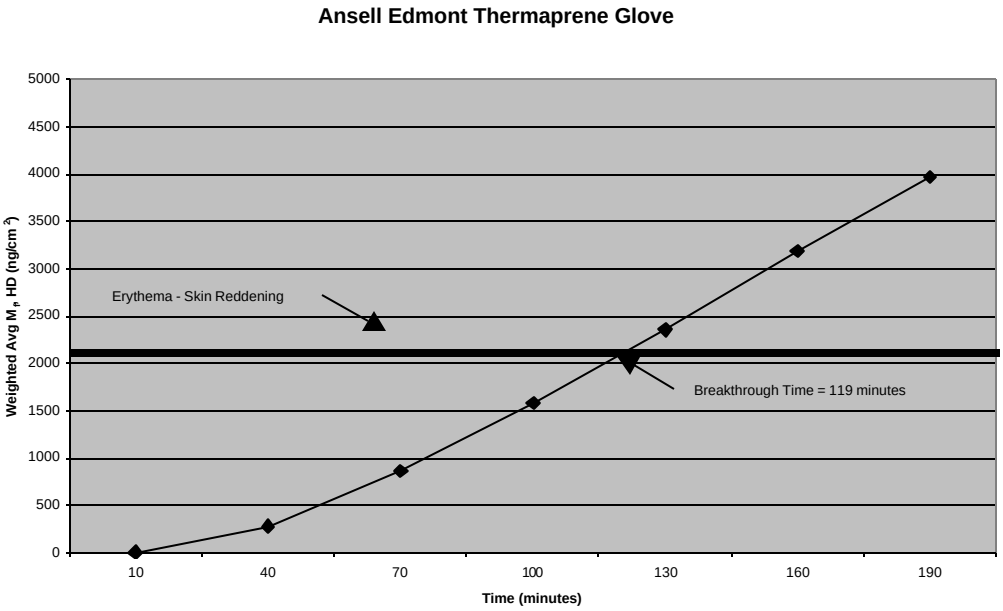

Figure D- 2: Ansell Edmont Thermaprene Glove - Average HD Cumulative Permeation

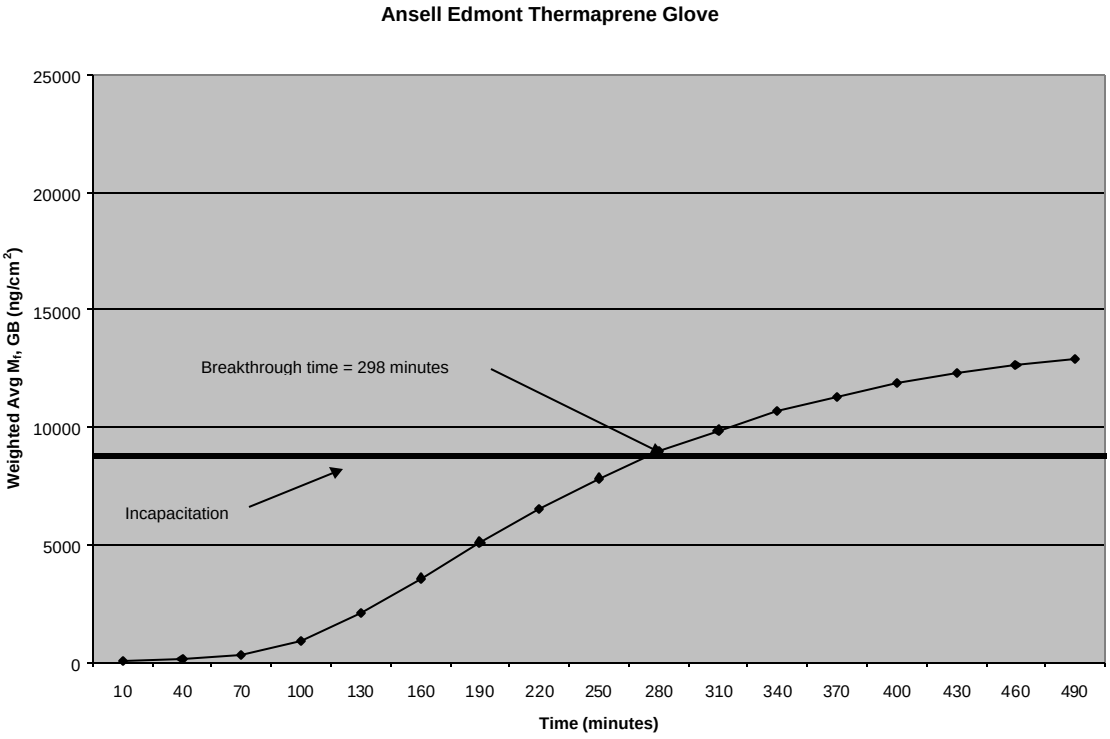

Figure D- 3: Ansell Edmont Thermaprene Glove -Average GB Cumulative Permeation

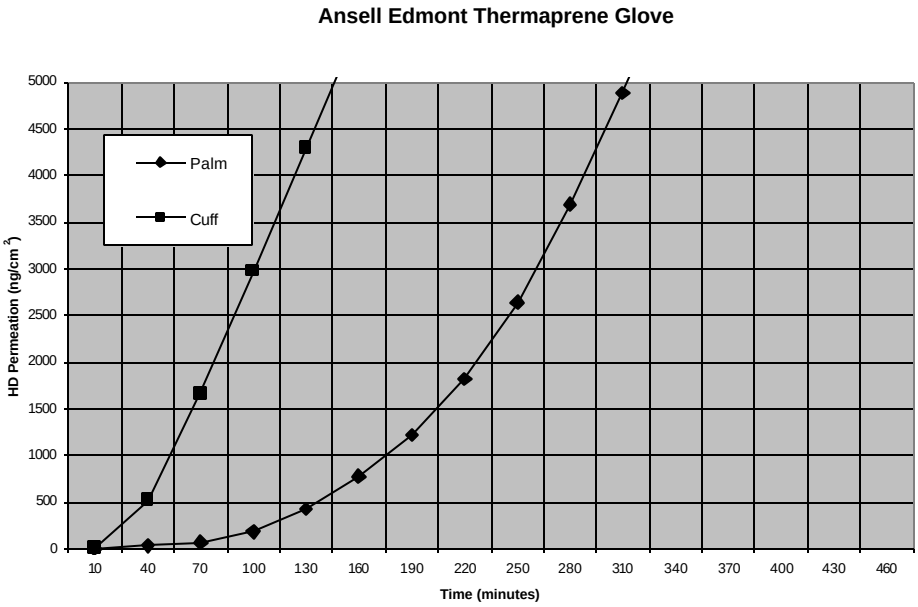

Figure D- 4: Ansell Edmont Thermaprene Glove - HD Cumulative Permeation by Sampling Area

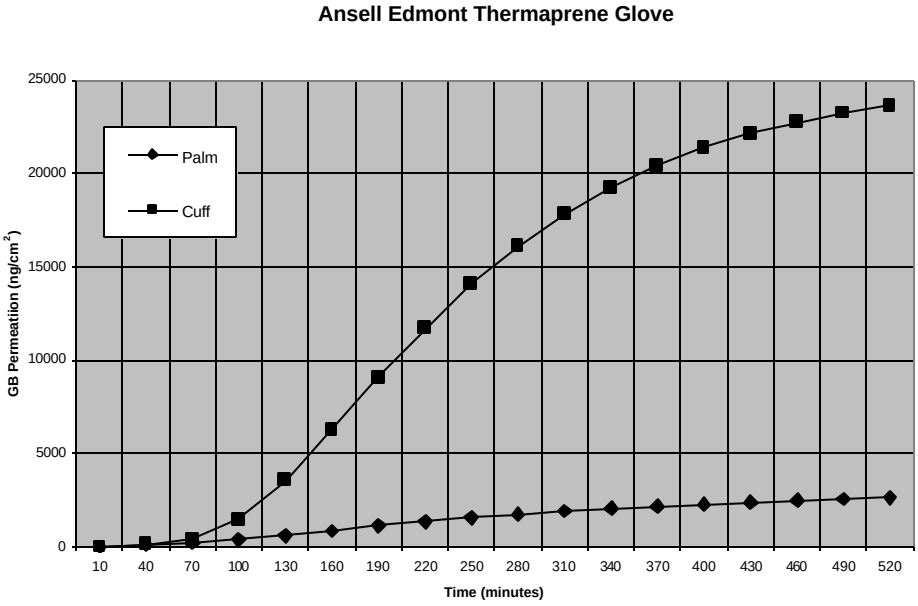

Figure D- 5: Ansell Edmont Thermaprene Glove - GB Cumulative Permeation by Sampling Area

Appendix E -

BAYSIDE LATEX

Figure E- 1: Bayside Latex Examination Glove

Table E- 1. Bayside Latex Glove - Average HD Permeation

Bayside Latex Glove (GL1-LXEXR)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
7	0	10	1	9	1
37	4283	40	4332	39	4308
67	12712	70	12920	69	12816
97	21094	100	21531	99	21313
127	29576	130	30226	129	29901
157	38066	160	38933	159	38500
187	46570	190	47636	189	47103
217	55079	220	56277	219	55678
247	63457	250	64644	249	64050
277	71110	280	71845	279	71477
307	77511	310	77232	309	77372
337	82446	340	81144	339	81795
367	86118	370	84079	369	85099
397	88987	400	86374	399	87680
427	91234	430	88234	429	89734
457	93053	460	89788	459	91421
		489	91060		
		516	92090		
		543	93010		
		570	93838		
		597	94595		
		624	95287		
		651	95931		
		678	96535		

Table E- 2. Bayside Latex Glove - Average GB Permeation

Bayside Latex Glove (GL1-LXEXR)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
8	7	11	10	9	9
38	2433	41	2425	39	2429
68	7284	71	7255	69	7269
98	12215	101	12171	99	12193
128	17175	131	17130	129	17152
158	22133	161	22086	159	22109
188	26981	191	26989	189	26985
218	31558	221	31684	219	31621
248	35766	251	35990	249	35878
278	39549	281	39838	279	39694
308	42911	311	43258	309	43085
338	45911	341	46311	339	46111
368	48587	371	49028	369	48808
398	50984	401	51455	399	51220
428	53148	431	53640	429	53394
458	55120	461	55617	459	55368
488	56918	491	57411	489	57164
518	58550	521	59049	519	58800
548	60042	551	60551	549	60296
578	61414	581	61918	579	61666
608	62678	611	63176	609	62927
638	63848	641	64340	639	64094
668	64935	671	65413	669	65174
698	65945	701	66413	699	66179
728	66887	731	67343	729	67115
758	67762	761	68204	759	67983
788	68566	791	69002	789	68784
818	69306	821	69737	819	69521
848	69997	851	70422	849	70209
878	70640	881	71063	879	70852
908	71242	911	71660	909	71451
938	71814	941	72218	939	72016
968	72350	971	72744	969	72547
998	72858	1001	73242	999	73050
1028	73344	1031	73715	1029	73530
1058	73801	1061	74166	1059	73984
1088	74233	1091	74589	1089	74411
1118	74647	1121	74990	1119	74818
1148	75041	1151	75371	1149	75206
1178	75415	1181	75731	1179	75573
1208	75772	1211	76074	1209	75923
1238	76113	1241	76399	1239	76256
1268	76437	1271	76709	1269	76573
1298	76746	1301	77003	1299	76875
1328	77043	1331	77285	1329	77164
1358	77337	1361	77563	1359	77450
1388	77626	1391	77835	1389	77731
1418	77902	1421	78093	1419	77997

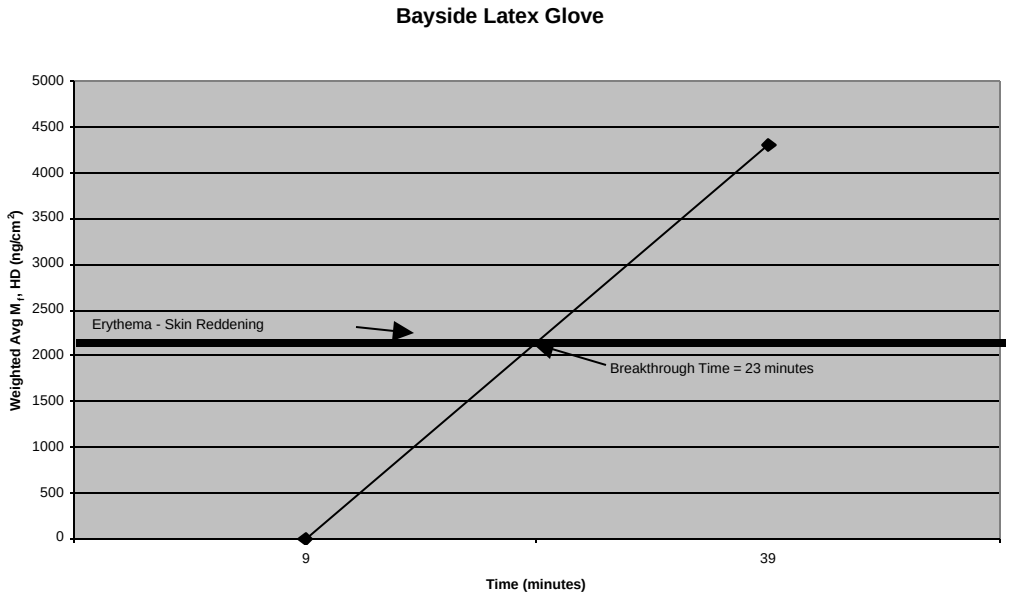

Figure E- 2: Bayside Latex Glove - Average HD Cumulative Permeation

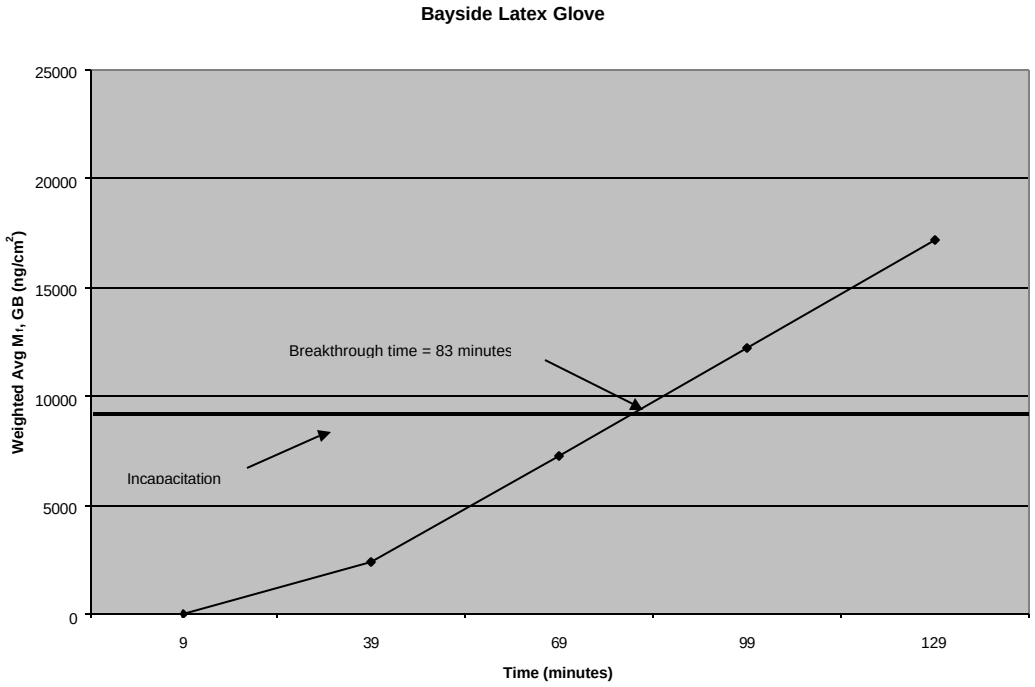

Figure E- 3: Bayside Latex Glove - Average GB Cumulative Permeation

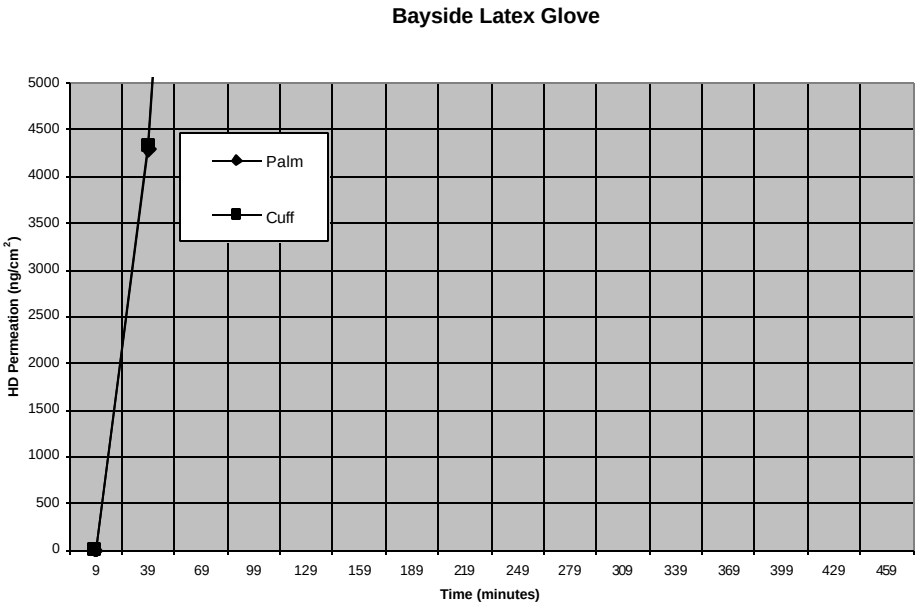

Figure E- 4: Bayside Latex Glove: HD Cumulative Permeation By Sampling Area

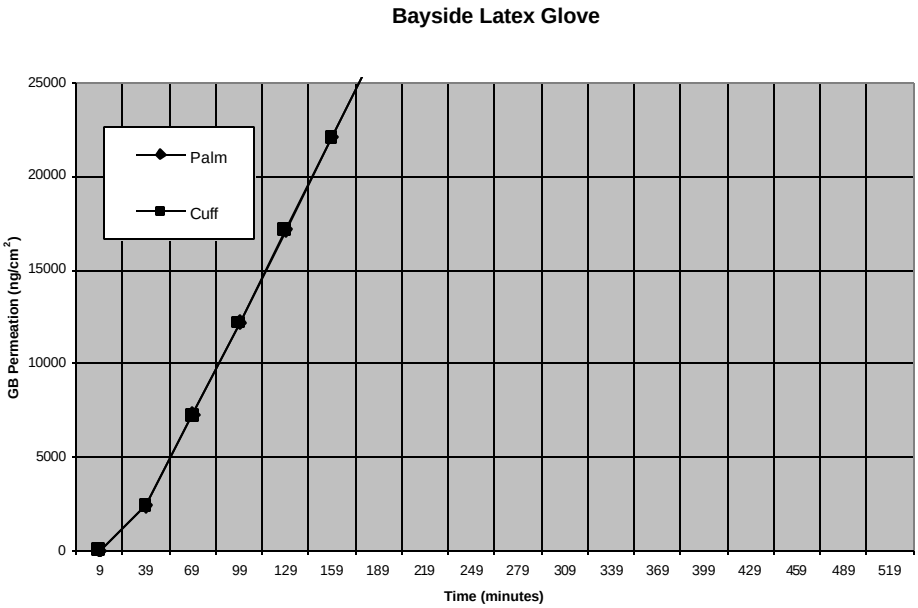

Figure E- 5: Bayside Latex Glove: GB Cumulative Permeation By Sampling Area

Appendix F -

SAFETY ZONE

Figure F- 1: Safety Zone Glove

Table F- 1. Safety Zone Glove - Average HD Permeation

Safety Zone Glove (GL1-NPFL)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
8	36	11	50	9	43
38	215	41	237	40	226
68	4387	71	4206	70	4296
99	13228	102	12948	100	13088
129	22732	132	22565	131	22648
159	32306	162	32268	161	32287
190	41877	193	41967	191	41922
220	51546	223	51640	222	51593
250	61107	253	61330	252	61219
281	70595	284	70974	282	70784
311	80161	314	80649	313	80405
341	89678	344	90353	343	90016
372	99078	375	100066	373	99572

Table F- 2. Safety Zone Glove – Average GB Permeation

Safety Zone Glove (GL1-NPFL)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
7	2	9	8	8	5
36	35	39	60	38	48
66	1728	69	959	68	1344
96	6777	99	4937	98	5857
126	13685	129	11475	128	12580
156	20764	159	18398	158	19581
186	27841	189	25372	188	26606
216	34905	219	32322	218	33614
246	41945	249	39238	248	40592
276	48938	279	46117	278	47528
306	55818	309	52905	308	54361
336	62555	339	59592	338	61073
366	69177	369	66246	368	67711
396	75640	399	72874	398	74257
426	81968	429	79453	428	80711
456	88100	459	85946	458	87023
486	93983	489	92258	488	93121
516	99658	519	98393	518	99025

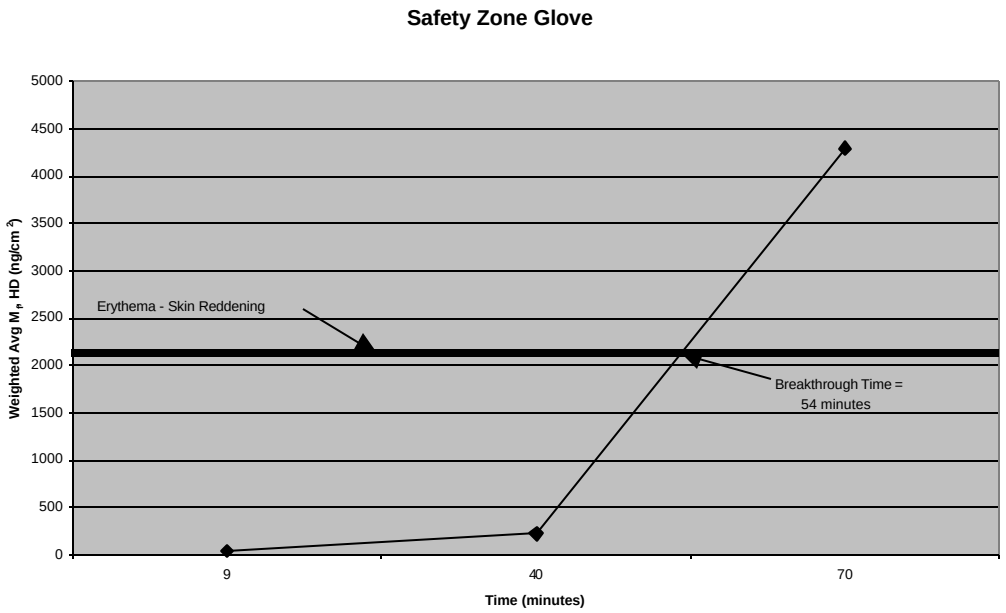

Figure F- 2: Safety Zone Glove - Average HD Cumulative Permeation

Figure F- 3: Safety Zone Glove - Average GB Cumulative Permeation

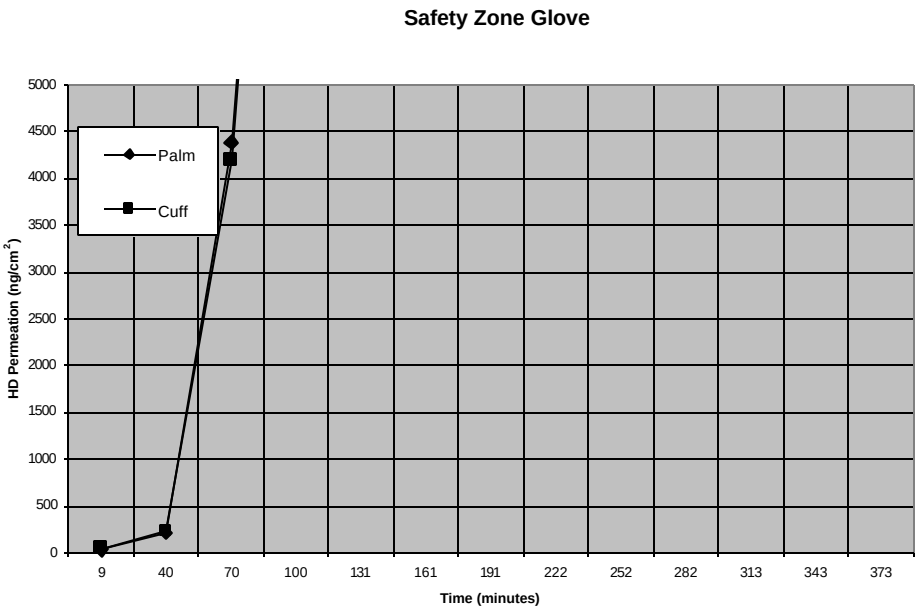

Figure F- 4: Safety Zone Glove - HD Cumulative Permeation by Sampling Area

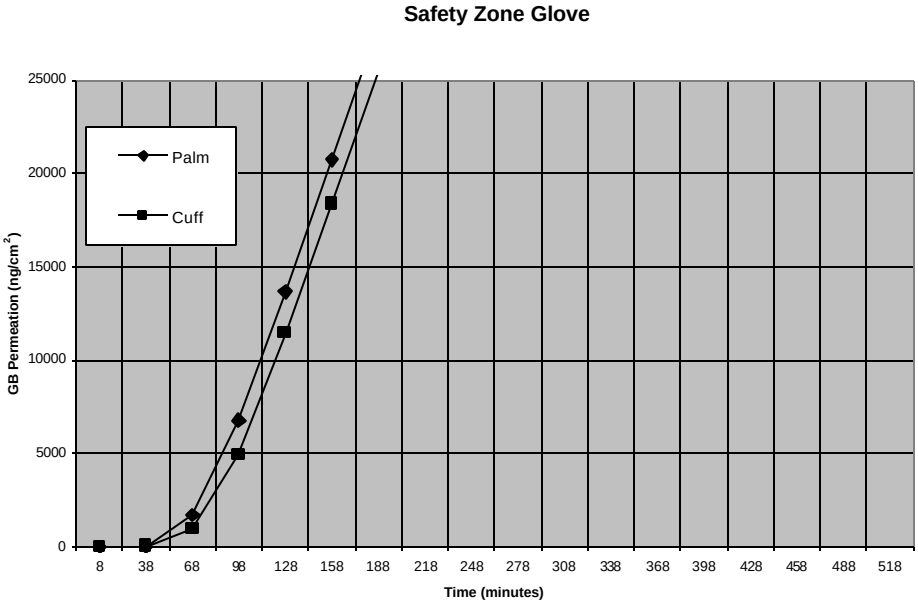

Figure F- 5: Safety Zone Glove - GB Cumulative Permeation by Sampling Area

Appendix G -

MAPA NEOPRENE

Figure G- 1: MAPA Neoprene Glove

Table G- 1. MAPA Neoprene Glove - Average HD Permeation

MAPA Neoprene Glove (PN1-N450)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
4	3	13	6	9	5
34	36	43	25	39	31
64	64	73	38	69	51
94	96	103	54	99	75
124	128	133	71	129	100
154	164	163	106	159	135
184	205	193	242	189	224
214	257	223	677	219	467
244	335	253	1529	249	932
274	466	283	2711	279	1589
304	682	313	4051	309	2367
334	1021	343	5422	339	3222
364	1518	373	6783	369	4151
394	2200	403	8133	399	5167
424	3084	433	9473	429	6279
454	4153	463	10803	459	7478
484	5357	493	12118	489	8738
514	6640	523	13423	519	10032
544	7958	553	14721	549	11340
574	9278	583	16017	579	12648
604	10593	613	17313	609	13953
634	11905	643	18606	639	15256
664	13212	673	19898	669	16555
694	14514	703	21183	699	17849
724	15809	733	22460	729	19135
754	17097	763	23736	759	20417
784	18390	793	25021	789	21706
814	19684	823	26301	819	22993
844	20970	853	27576	849	24273
874	22260	883	28854	879	25557
904	23547	913	30129	909	26838
934	24828	943	31395	939	28112
964	26105	973	32655	969	29380
994	27373	1003	33912	999	30643
1024	28646	1033	35177	1029	31912
1054	29929	1063	36446	1059	33188
1084	31210	1093	37737	1089	34474
1114	32538	1123	39070	1119	35804
1144	33987	1153	40537	1149	37262
1174	35545	1183	42106	1179	38826
1204	37123	1213	43652	1209	40388
1234	38682	1243	45191	1239	41937
1264	40232	1273	46724	1269	43478
1294	41766	1303	48238	1299	45002
1324	43283	1333	49735	1329	46509
1354	44786	1363	51217	1359	48002
1384	46286	1393	52697	1389	49492
1414	47785	1423	54175	1419	50980

Table G- 2. MAPA Neoprene Glove - Average GB Permeation

MAPA Neoprene Glove (PN1-N450)					
M_f, Average Permeation (ng/cm^2)					
Time (min)	Palm	Time (min)	Cuff	Average Time (min)	Weighted Avg M_f
6	1	9	2	8	2
36	23	39	17	38	20
66	45	69	37	68	41
96	66	99	54	98	60
126	85	129	68	128	77
156	102	159	81	158	92
186	118	189	93	188	106
216	133	219	105	218	119
246	146	249	114	248	130
276	158	279	123	278	140
306	169	309	131	308	150
336	180	339	138	338	159
366	189	369	145	368	167
396	198	399	152	398	175
426	207	429	158	428	182
456	215	459	163	458	189
486	222	489	168	488	195
516	229	519	173	518	201
546	235	549	178	548	206
576	241	579	183	578	212
606	247	609	187	608	217
636	253	639	191	638	222
666	259	669	196	668	227
696	265	699	200	698	233
726	271	729	206	728	239
756	278	759	213	758	246
786	284	789	220	788	252
816	291	819	226	818	258
846	297	849	232	848	264
876	303	879	238	878	270
906	309	909	244	908	276
936	314	939	249	938	282
966	319	969	255	968	287
996	325	999	260	998	292
1026	330	1029	265	1028	297
1056	335	1059	270	1058	302
1086	340	1089	275	1088	307
1116	345	1119	280	1118	312
1146	349	1149	285	1148	317
1176	354	1179	289	1178	322
1206	358	1209	293	1208	326
1236	363	1239	298	1238	330
1266	367	1269	302	1268	335
1296	372	1299	307	1298	339
1326	376	1329	312	1328	344
1356	381	1359	316	1358	349
1386	385	1389	321	1388	353
1416	390	1419	325	1418	358

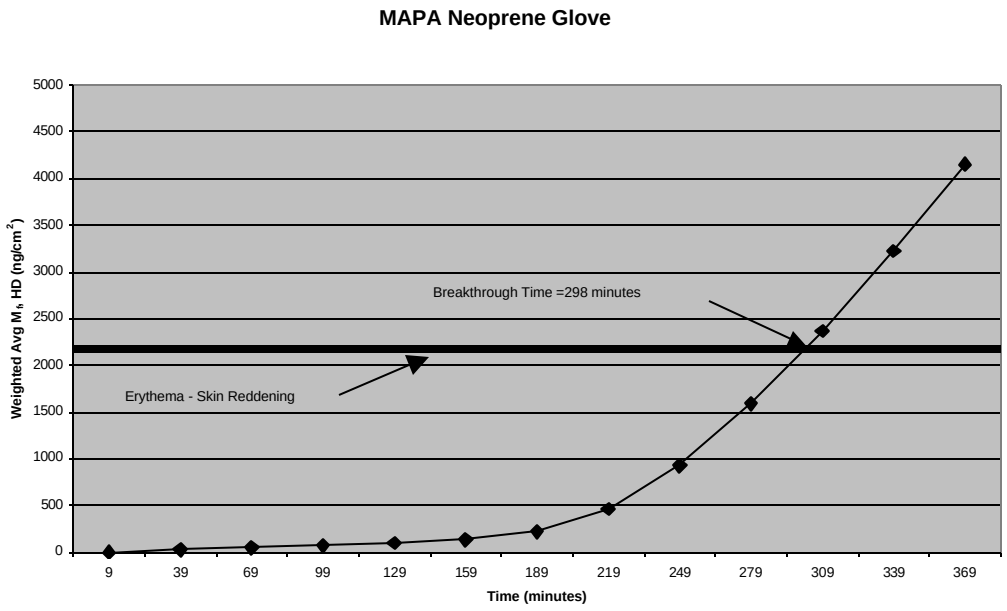

Figure G- 2: MAPA Neoprene Glove - Average HD Cumulative Permeation

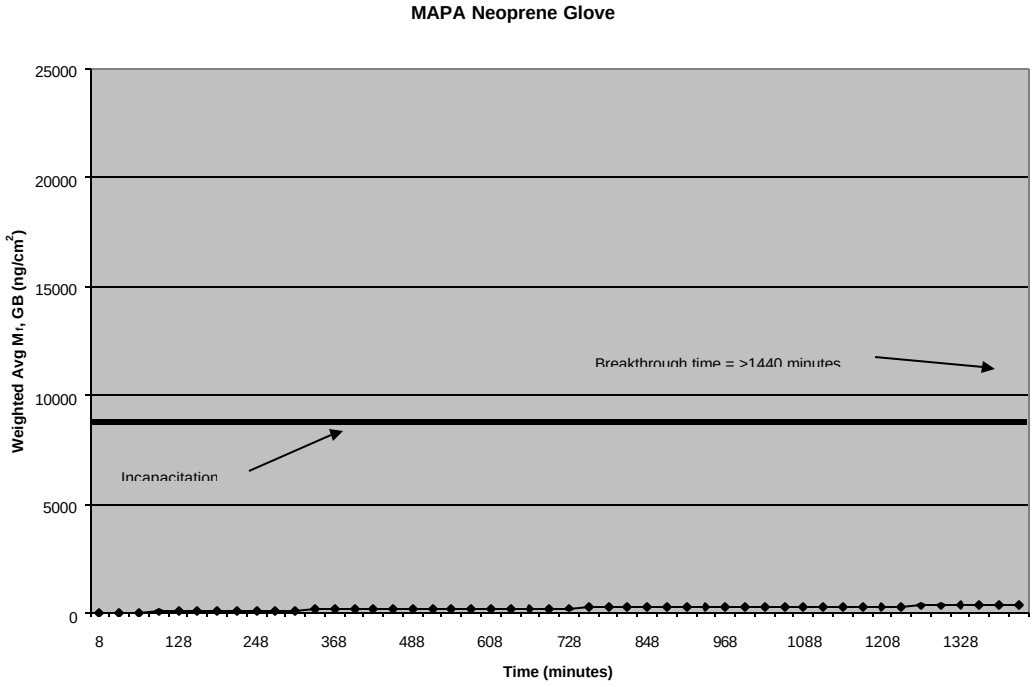

Figure G- 3: MAPA Neoprene Glove - Average GB Cumulative Permeation

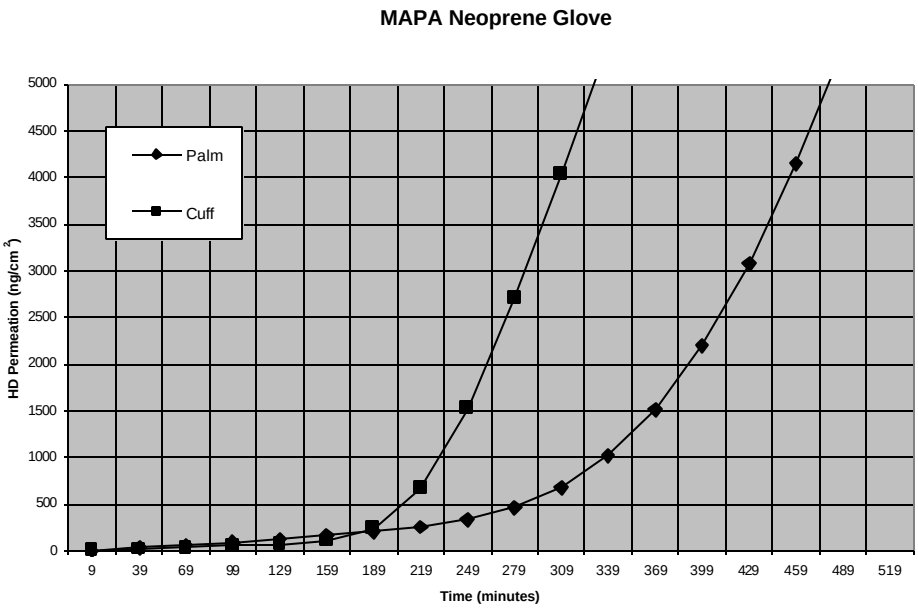

Figure G- 4: MAPA Neoprene Glove: HD Cumulative Permeation by Sampling Area

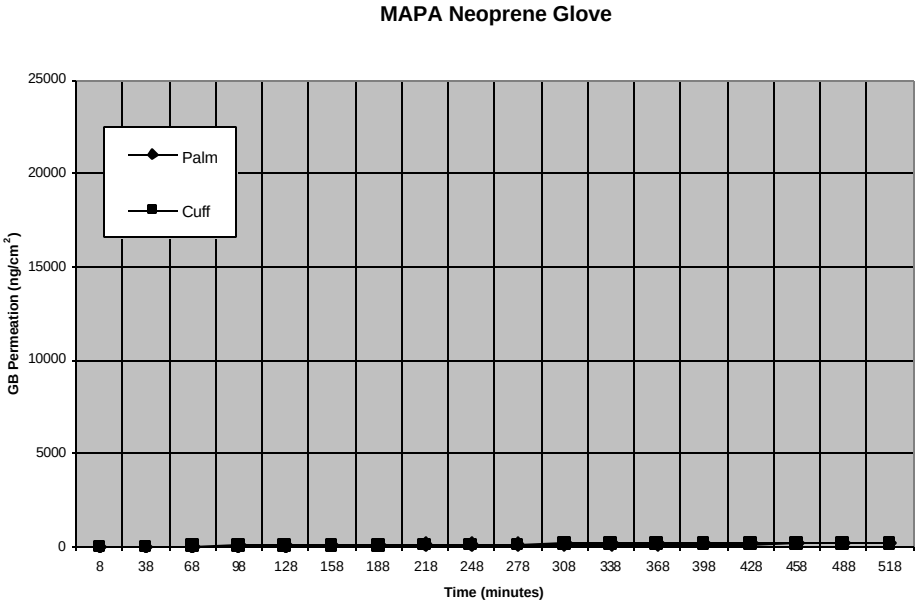

Figure G- 5: MAPA Neoprene Glove: GB Cumulative Permeation by Sampling Area

Appendix H -

ANSELL EDMONT TNT NITRILE

Figure H- 1: Ansell Edmont TNT Nitrile Glove

Table H- 1. Ansell Edmont TNT Nitrile Glove - Average HD Permeation

Ansell Edmont TNT Nitrile Glove (92-500)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
7	12	10	48	8	30
37	4898	40	5134	38	5016
67	14488	70	14926	68	14707
97	24037	100	24591	98	24314
127	33465	130	34184	128	33824
157	42791	160	43601	158	43196
187	52155	190	52910	188	52532
217	61404	220	62198	218	61801
247	70535	250	71406	248	70970
277	79506	280	80565	278	80036
307	88240	310	89637	308	88938
337	96662	340	98553	338	97608

Table H- 2. Ansell Edmont TNT Nitrile Glove - Average GB Permeation

Ansell Edmont TNT Nitrile Glove (92-500)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
7	0	10	0	8	0
37	1305	40	997	38	1151
67	5006	70	3377	68	4192
97	10017	100	6488	98	8253
127	15287	130	10109	128	12698
157	20581	160	13948	158	17265
187	25833	190	17834	188	21834
217	31021	220	21701	218	26361
247	36157	250	25532	248	30844
277	41230	280	29327	278	35278
307	46208	310	33082	308	39645
337	51095	340	36741	338	43918
367	55897	370	40328	368	48113
397	60627	400	43897	398	52262
427	65314	430	47426	428	56370
457	69907	460	50895	458	60401
487	74343	490	54279	488	64311
517	78596	520	57551	518	68074
547	82650	550	60688	548	71669
577	86542	580	63697	578	75119
607	90275	610	66596	608	78436
635	93634				
662	96750				

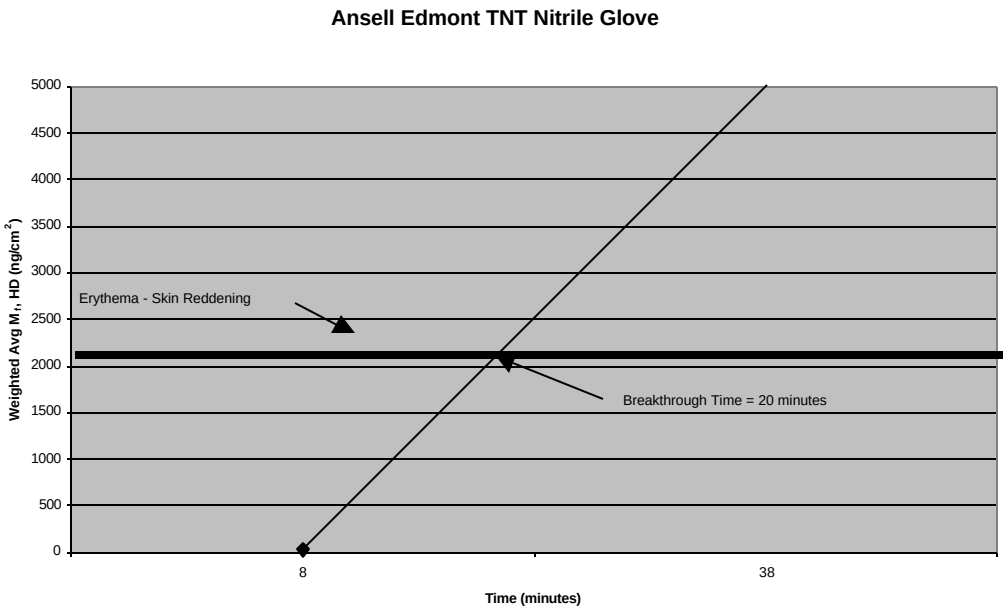

Figure H- 2: Ansell Edmont TNT Nitrile Glove - Average HD Cumulative Permeation

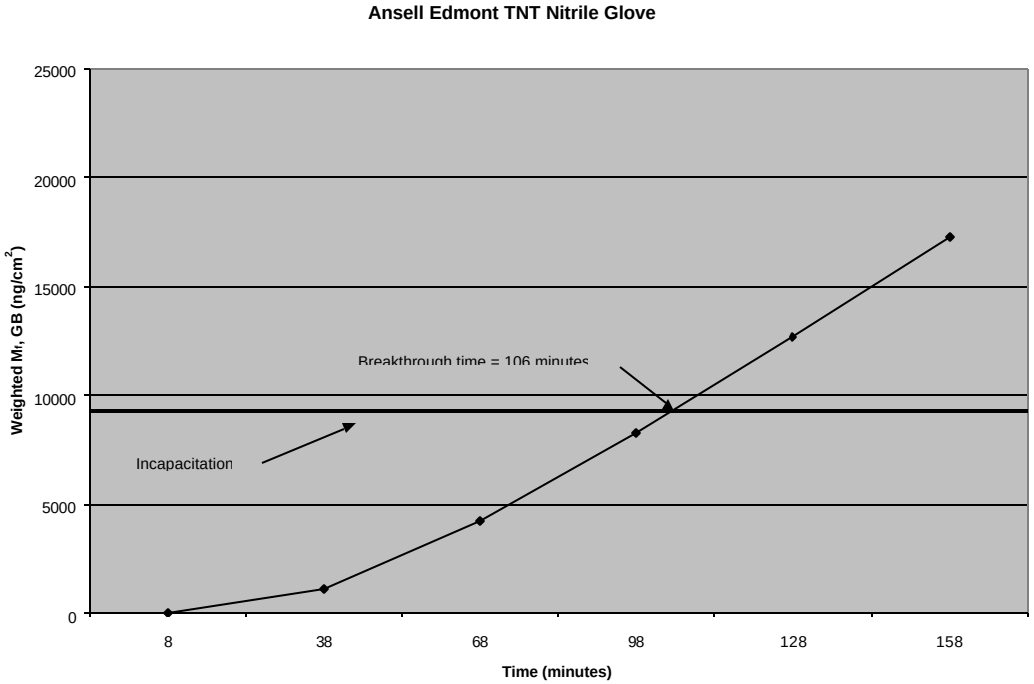

Figure H- 3: Ansell Edmont TNT Nitrile Glove - Average GB Cumulative Permeation

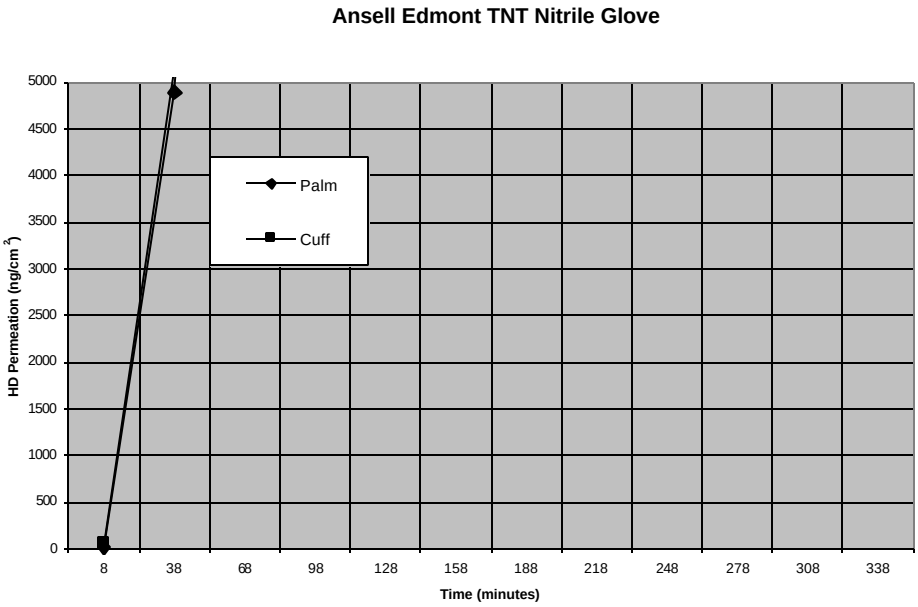

Figure H- 4: Ansell Edmont TNT Nitrile Glove: HD Cumulative Permeation by Sampling Area

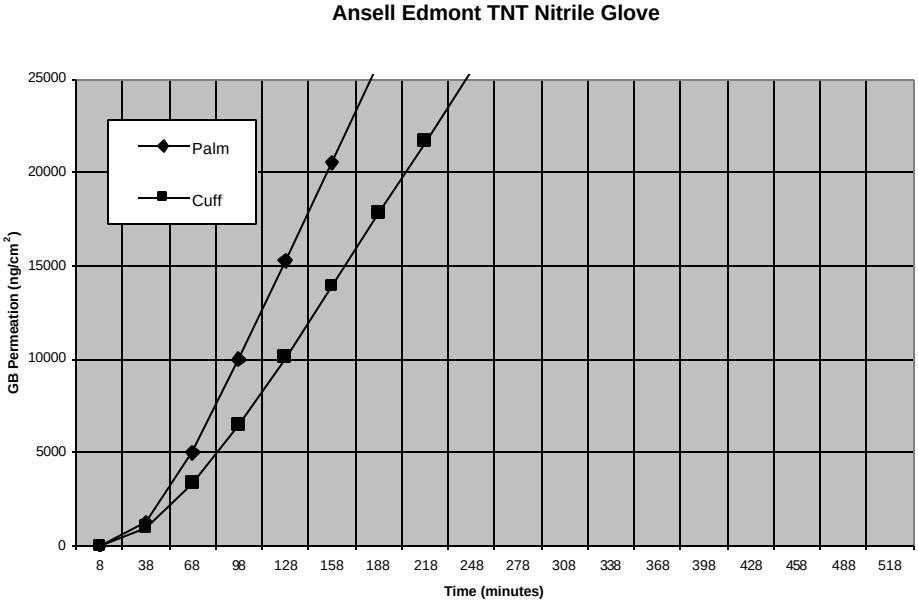

Figure H- 5: Ansell Edmont TNT Nitrile Glove: GB Cumulative Permeation by Sampling Area

Appendix I -

ANSELL EDMONT PVA

Figure I- 1: Ansell Edmont PVA Glove

Table I- 1. Ansell Edmont PVA Glove - Average HD Permeation

Ansell Edmont PVA Glove (15-554)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
7	3	10	10	9	7
38	31	41	51	39	41
68	56	71	93	70	75
98	98	102	154	100	126
129	154	132	228	130	191
159	222	162	315	161	268
189	299	193	410	191	355
220	386	223	515	221	450
250	479	253	628	252	554
281	581	284	749	282	665
311	688	314	878	312	783
341	803	344	1014	343	908
372	922	375	1158	373	1040
402	1047	405	1311	403	1179
432	1177	435	1471	434	1324
463	1312	466	1637	464	1475
493	1449	496	1811	494	1630
523	1588	526	1994	525	1791
554	1729	557	2182	555	1955
584	1871	587	2372	585	2122
614	2013	617	2564	616	2288
645	2155	648	2754	646	2455
675	2296	678	2944	676	2620
705	2435	708	3133	707	2784
736	2571	739	3321	737	2946
766	2706	769	3508	767	3107
796	2838	799	3691	798	3265
827	2969	830	3873	828	3421
857	3097	860	4052	858	3575
887	3224	890	4230	889	3727
918	3350	921	4410	919	3880
948	3480	951	4594	949	4037
978	3613	981	4783	980	4198
1009	3748	1012	4974	1010	4361
1039	3883	1042	5165	1040	4524
1069	4017	1072	5354	1071	4686
1100	4151	1103	5540	1101	4845
1130	4282	1133	5723	1131	5003
1160	4412	1163	5904	1162	5158
1191	4539	1194	6082	1192	5311
1221	4667	1224	6259	1222	5463
1251	4794	1254	6434	1253	5614
1282	4919	1285	6609	1283	5764
1312	5042	1315	6778	1313	5910
1342	5160	1345	6937	1344	6048
1373	5271	1376	7087	1374	6179
1403	5359	1406	7227	1404	6293

Table I- 2. Ansell Edmont PVA Glove - Average GB Permeation

Ansell Edmont PVA Glove (15-554)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
8	2	11	2	10	2
38	84	41	1461	39	773
68	781	71	6011	69	3396
98	2877	101	12711	100	7794
128	6340	131	19950	130	13145
158	10495	161	27173	160	18834
188	14842	191	34188	190	24515
218	19100	221	40799	220	29950
248	23112	251	46899	250	35006
278	26795	281	52472	280	39634
308	30121	311	57551	310	43836
338	33086	341	62158	340	47622
368	35683	371	66318	370	51000
398	37945	401	70064	400	54004
428	39922	431	73453	430	56687
458	41643	461	76524	460	59084
488	43133	491	79310	490	61222
518	44429	521	81851	520	63140
548	45561	551	84156	550	64859
578	46543	581	86250	580	66396
608	47386	611	88159	610	67772
639	48126	642	89926	640	69026
669	48787	672	91571	670	70179
697	49312				
724	49756				
751	50147				
778	50491				
805	50798				
833	51074				
860	51321				
887	51546				
914	51754				
941	51944				
968	52120				
996	52283				
1023	52436				
1049	52570				
1073	52684				
1097	52793				
1121	52895				
1142	52980				
1163	53060				
1185	53135				
1206	53206				
1227	53274				
1248	53339				
1269	53401				
1290	53460				
1311	53516				
1332	53570				
1354	53622				
1375	53670				
1396	53716				
1417	53761				

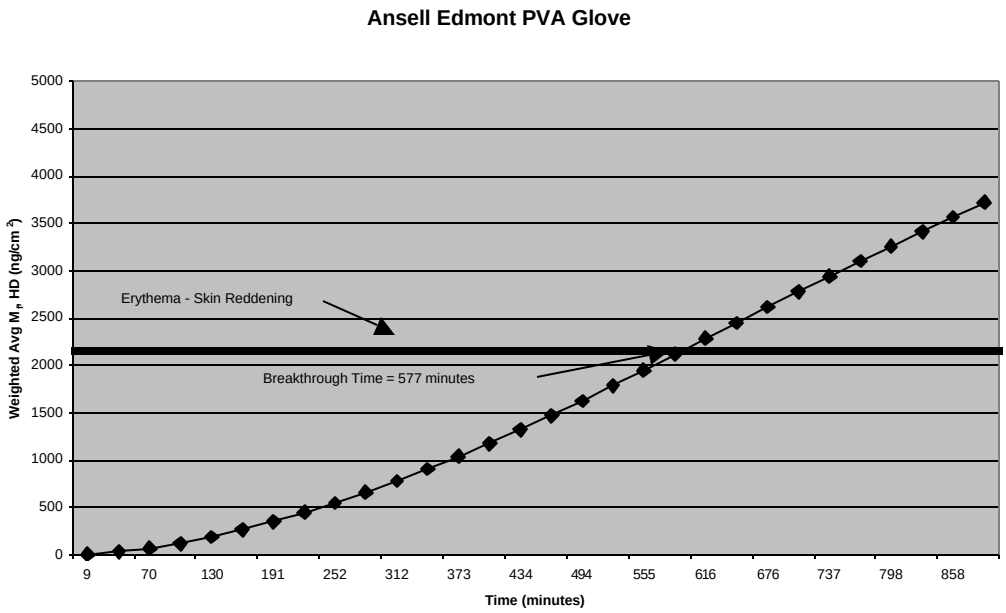

Figure I- 2: Ansell Edmont PVA Glove - Average HD Cumulative Permeation

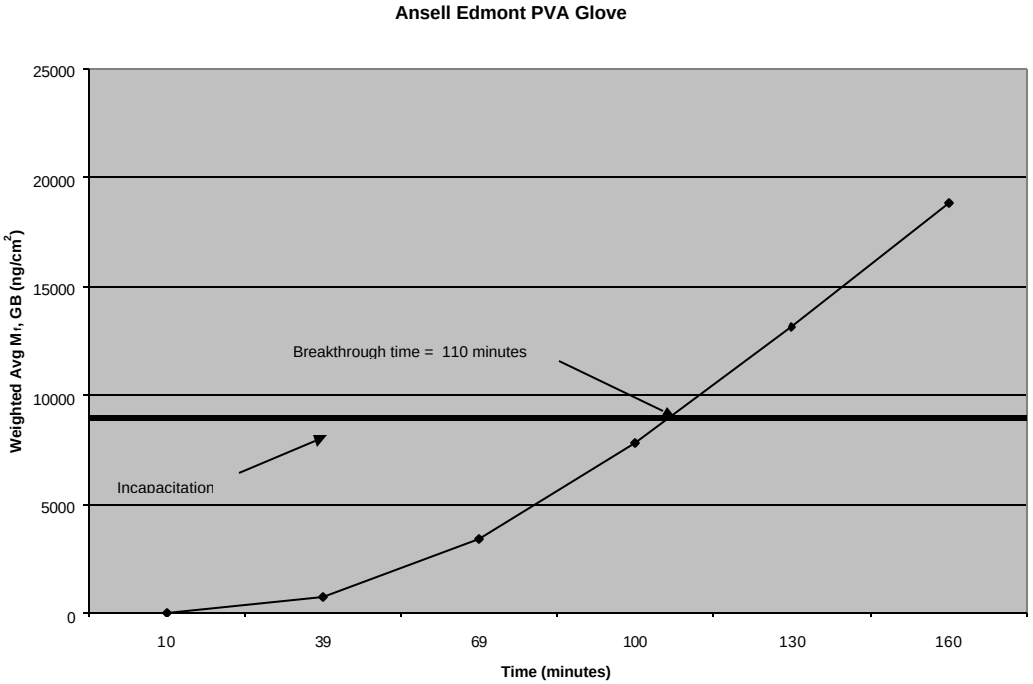

Figure I- 3: Ansell Edmont PVA Glove - Average GB Cumulative Permeation

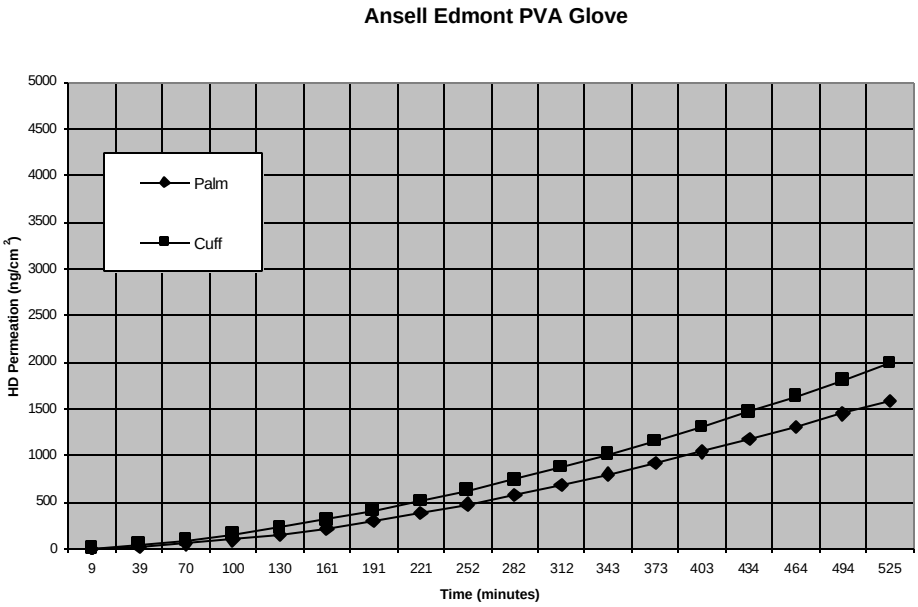

Figure I- 4: Ansell Edmont PVA Glove: HD Cumulative Permeation by Sampling Area

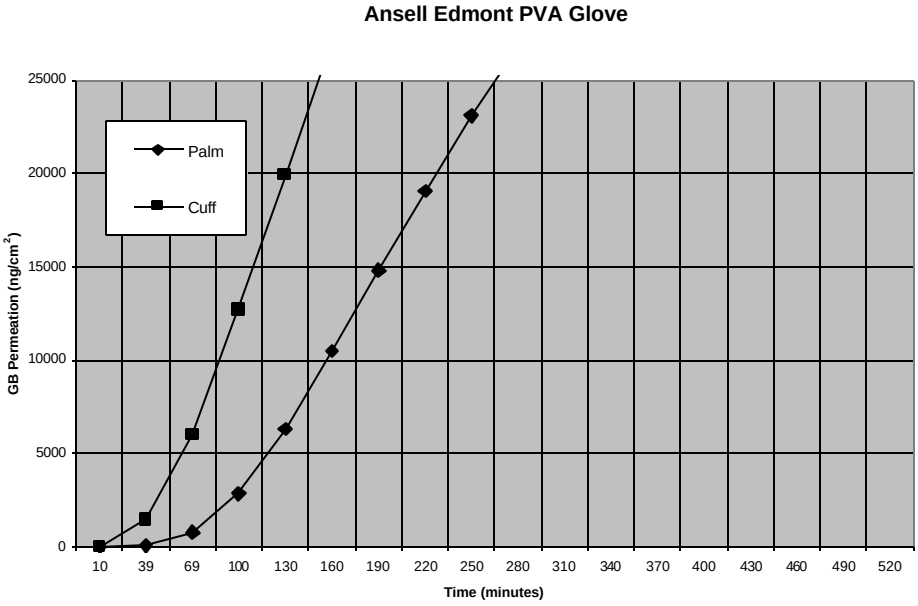

Figure I- 5: Ansell Edmont PVA Glove: GB Cumulative Permeation by Sampling Area

Appendix J -

HAHN FAT PVC

Figure J- 1: Hahn Fat PVC Glove

Table J- 1. Hahn Fat PVC Glove - Average HD Permeation

Hahn Fat PVC Glove (GL1-VC7714R)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
9	1	12	1	11	1
39	4	42	7	41	6
70	138	73	491	71	315
100	1366	103	3463	102	2414
130	4641	133	9817	132	7229
161	9668	164	17876	162	13772
191	15960	194	26329	193	21144
221	23012	224	34891	223	28952
252	30343	255	43513	253	36928
282	37838	285	52189	284	45014
312	45359	315	60928	314	53144
343	52898	346	69609	344	61254
373	60430	376	78211	375	69321
403	67884	406	86868	405	77376
434	75392	437	95574	435	85483
464	82987	467	104301	466	93644
491	89677				

Table J- 2. Hahn Fat PVC Glove - Average GB Permeation

Hahn Fat PVC Glove (GL1-VC7714R)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
9	2	12	2	10	2
39	17	42	15	41	16
69	793	72	125	71	459
99	3480	102	1012	101	2246
130	7730	133	3243	131	5487
160	12533	163	6427	161	9480
190	17481	193	9969	191	13725
220	22424	223	13578	222	18001
250	27357	253	17197	252	22277
280	32286	283	20829	282	26557
311	37203	314	24465	312	30834
341	42109	344	28099	342	35104
371	47003	374	31729	372	39366
401	51887	404	35346	403	43616
431	56760	434	38951	433	47856
461	61633	464	42554	463	52094
492	66521	495	46147	493	56334
522	71406	525	49729	523	60567
552	76276	555	53304	553	64790
582	81143	585	56870	584	69007
612	86005	615	60421	614	73213
642	90855	645	63956	644	77405
673	95707	676	67482	674	81594
703	100556	706	71000	704	85778

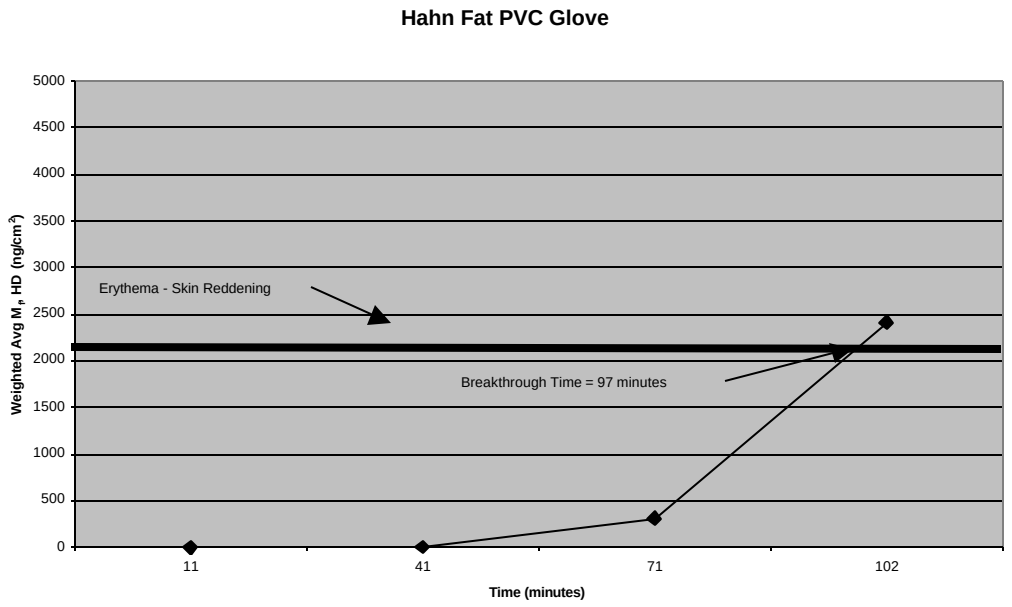

Figure J- 2: Hahn Fat PVC Glove - Average HD Cumulative Permeation

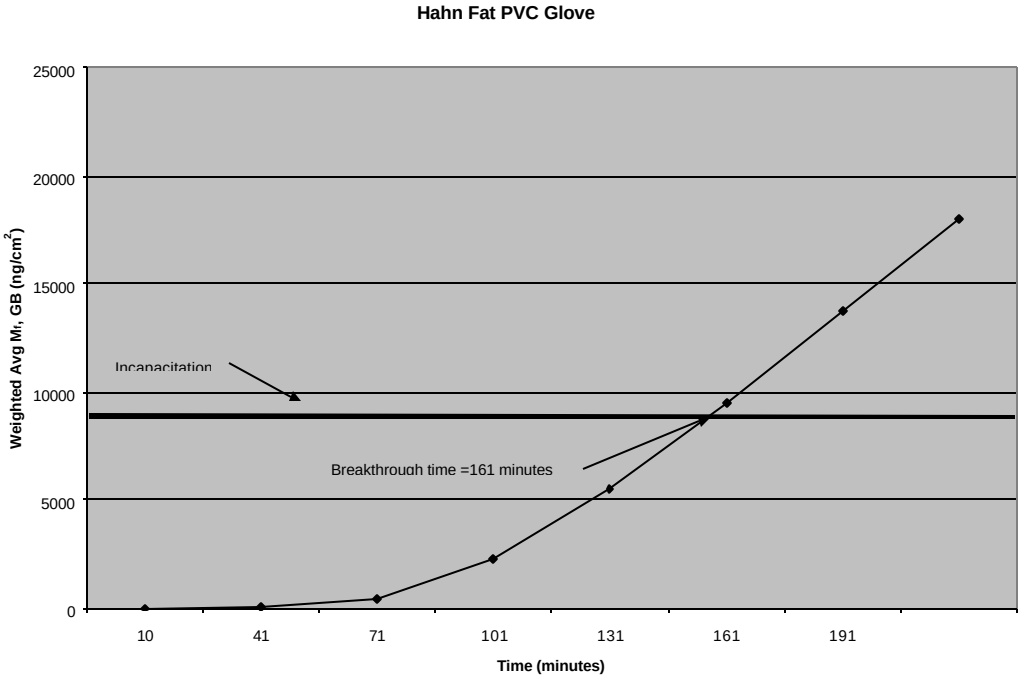

Figure J- 3: Hahn Fat PVC Glove - Average GB Cumulative Permeation

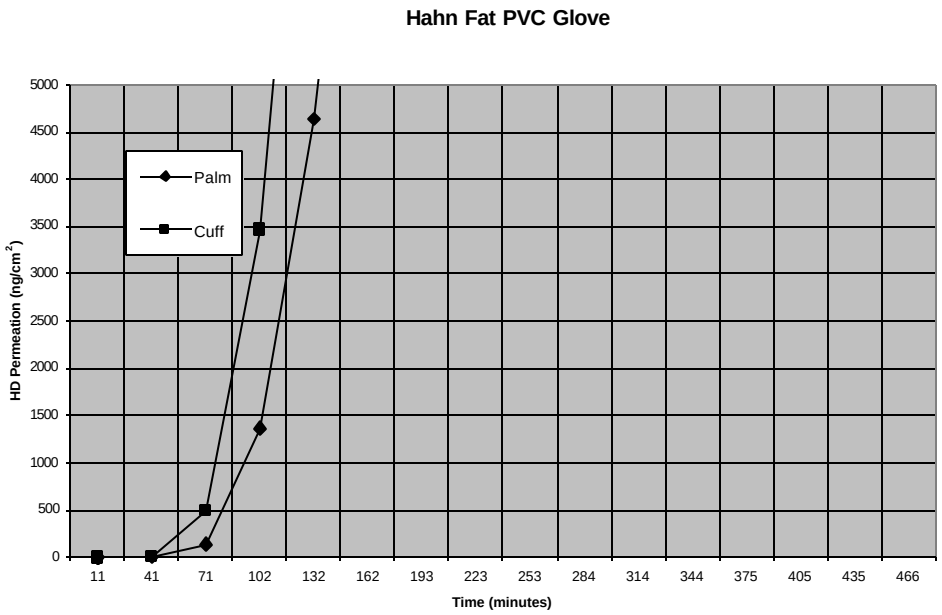

Figure J- 4: Hahn Fat PVC Glove: HD Cumulative Permeation by Sampling Area

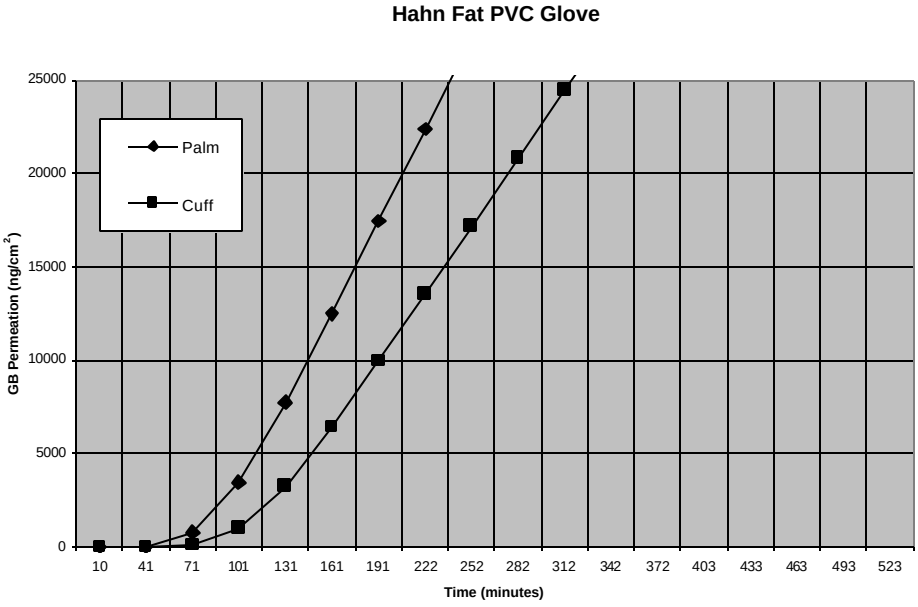

Figure J- 5: Hahn Fat PVC Glove: GB Cumulative Permeation by Sampling Area

Appendix K -

SAFETY 4H

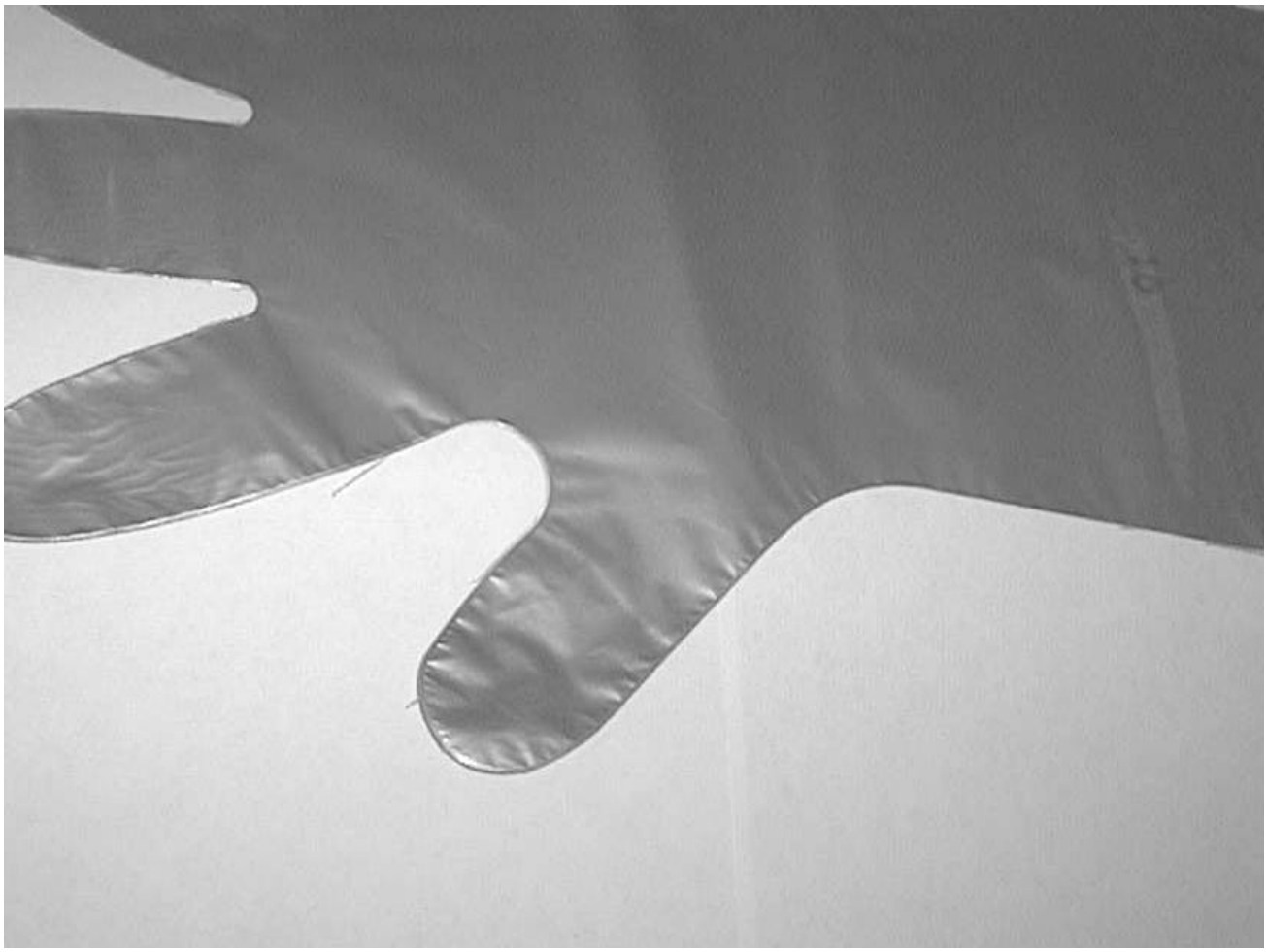

Figure K- 1: Safety 4H Glove

Table K- 1. Safety 4H Glove - Average HD Permeation

Safety 4 Glove (GS1-4H8735)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
7	0	10	0	9	0
38	3	41	3	39	3
68	6	71	7	69	6
98	9	101	9	99	9
128	14	131	14	130	14
158	22	161	23	160	22
188	33	191	34	190	33
219	47	222	48	220	47
249	64	252	64	250	64
279	82	282	83	280	83
309	102	312	104	311	103
339	123	342	127	341	125
369	145	372	152	371	149
400	169	403	178	401	173
430	193	433	205	431	199
460	218	463	233	461	225
490	242	493	262	492	252
520	267	523	290	522	279
550	291	553	319	552	305
581	316	584	349	582	332
611	341	614	378	612	359
641	366	644	407	642	387
671	391	674	438	673	415
701	417	704	469	703	443
731	443	734	501	733	472
762	469	765	534	763	501
792	495	795	566	793	530
822	521	825	598	823	559
852	547	855	630	854	589
882	573	885	663	884	618
912	600	915	696	914	648
943	625	946	729	944	677
973	651	976	761	974	706
1003	676	1006	794	1004	735
1033	702	1036	828	1035	765
1063	728	1066	861	1065	794
1093	754	1096	894	1095	824
1124	779	1127	927	1125	853
1154	806	1157	961	1155	883
1184	832	1187	994	1185	913
1214	858	1217	1028	1216	943
1244	884	1247	1062	1246	973
1274	910	1277	1096	1276	1003
1305	936	1308	1130	1306	1033
1335	962	1338	1165	1336	1063
1365	989	1368	1200	1366	1095
1395	1016	1398	1236	1397	1126
1425	1044	1428	1272	1427	1158

Table K- 2. Safety 4H Glove - Average GB Permeation

Safety 4H Glove (GS1-4H8735)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
8	1	11	3	9	2
38	20	41	27	39	23
68	54	71	61	69	58
98	90	101	94	100	92
128	122	131	122	130	122
158	150	161	147	160	148
188	174	191	169	190	172
219	196	222	188	220	192
249	215	252	205	250	210
279	232	282	220	280	226
309	247	312	233	310	240
339	261	342	245	340	253
369	274	372	256	371	265
399	285	402	266	401	276
429	296	432	276	431	286
459	306	462	284	461	295
489	316	492	293	491	304
519	325	522	300	521	312
549	333	552	307	551	320
580	340	583	313	581	327
610	347	613	320	611	333
640	354	643	325	641	340
670	360	673	331	671	345
700	366	703	336	702	351
730	372	733	340	732	356
760	377	763	345	762	361
791	382	794	349	792	366
821	387	824	353	822	370
851	392	854	357	852	374
881	396	884	360	882	378
911	400	914	364	912	382
941	404	944	367	943	386
971	408	974	370	973	389
1001	411	1004	373	1003	392
1031	415	1034	376	1033	396
1062	418	1065	379	1063	399
1092	421	1095	382	1093	402
1122	425	1125	385	1123	405
1152	430	1155	389	1153	410
1182	434	1185	393	1183	414
1212	439	1215	396	1214	418
1242	443	1245	400	1244	422
1272	448	1275	404	1274	426
1303	452	1306	407	1304	430
1333	456	1336	411	1334	433
1363	460	1366	414	1364	437
1393	464	1396	417	1394	440
1423	467	1426	420	1425	444

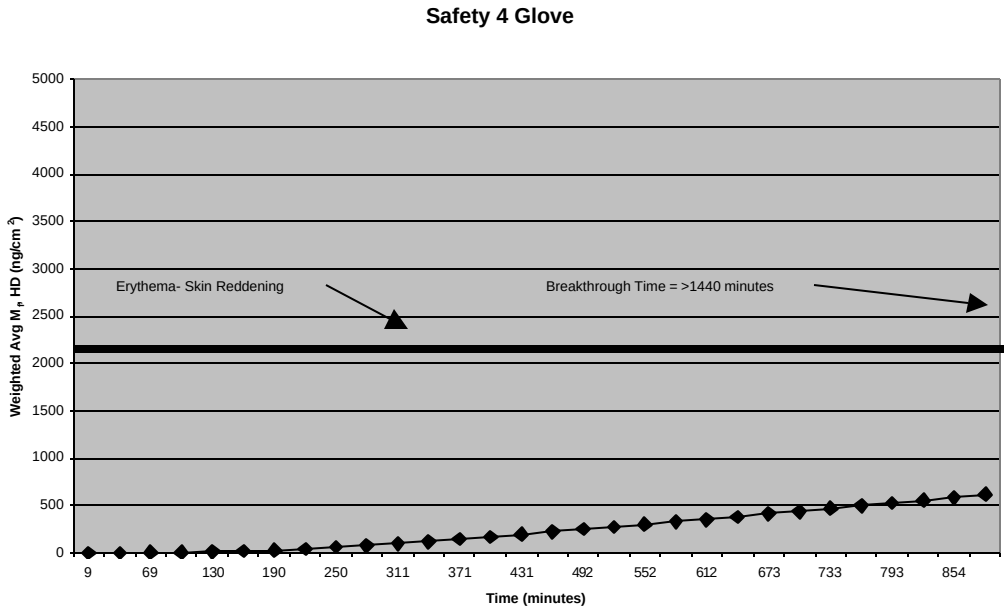

Figure K- 2: Safety 4H Glove - Average HD Cumulative Permeation

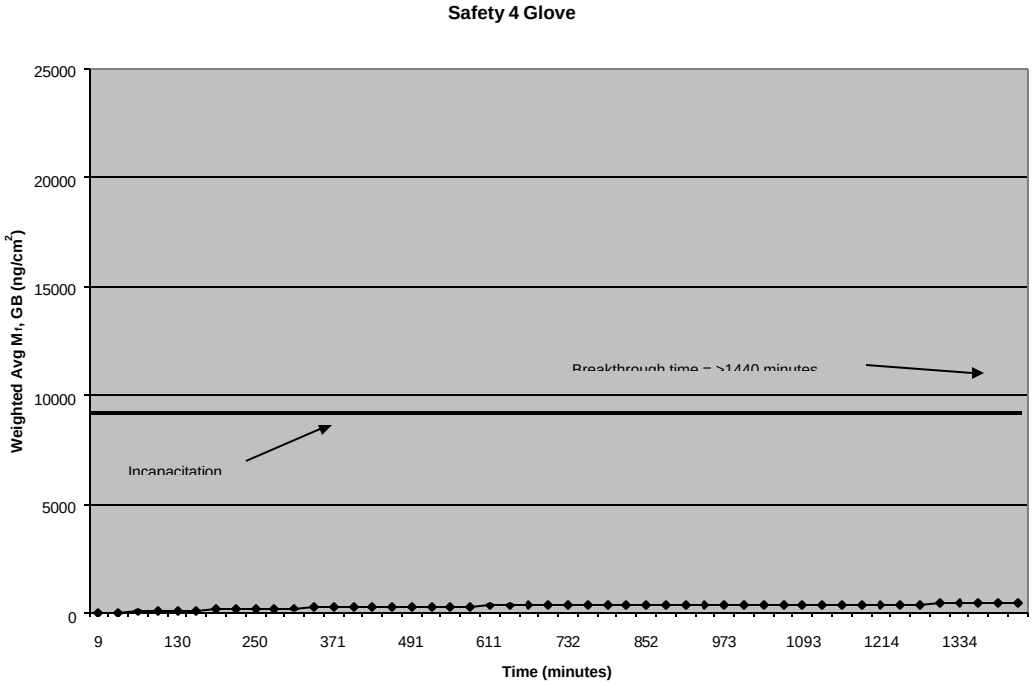

Figure K- 3: Safety 4H Glove - Average GB Cumulative Permeation

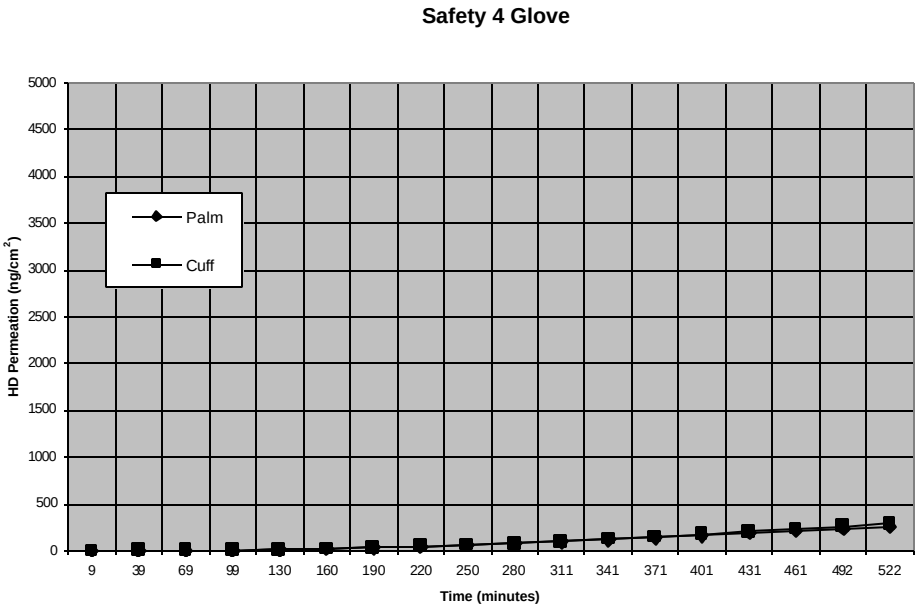

Figure K- 4: Safety 4H Glove: HD Cumulative Permeation by Sampling Area

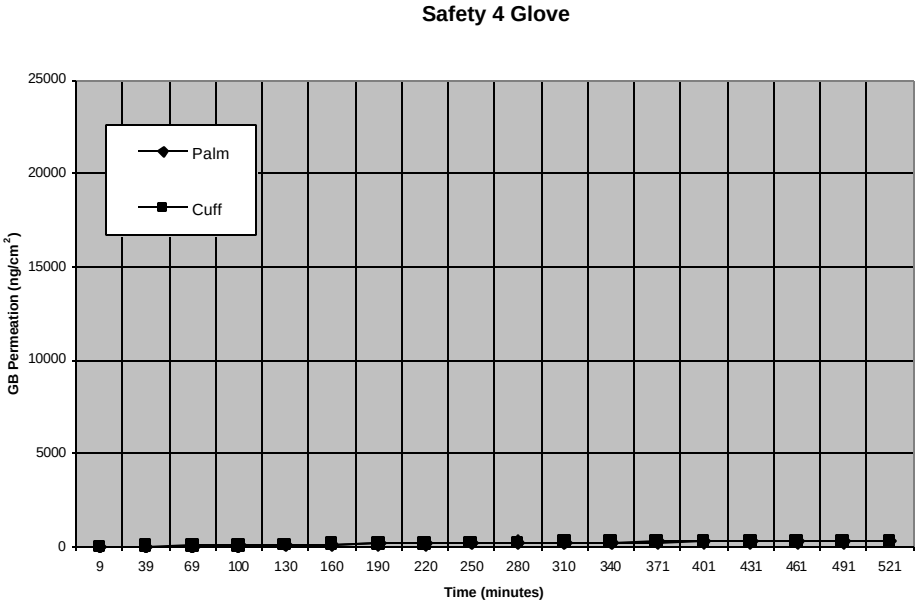

Figure K- 5: Safety 4H Glove: GB Cumulative Permeation by Sampling Area

Appendix L -

ANSELL EDMONT SOL-VEX

Figure L- 1: Ansell Edmont Sol-Vex Glove

Table L- 1. Ansell Edmont Sol-Vex Glove - Average HD Permeation

Ansell Edmont Solvex Glove (37-155)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
12	8	6	5	9	6
42	52	37	91	39	71
72	118	67	185	69	152
102	858	97	1516	100	1187
132	3104	127	5138	130	4121
162	6441	157	10126	160	8283
193	10087	188	15448	190	12768
223	13618	218	20364	220	16991
253	16886	248	24733	251	20810
283	19952	278	28793	281	24372
313	22804	308	32545	311	27675
344	25370	339	35872	341	30621
374	27692	369	38847	371	33270
404	29859	399	41579	401	35719
434	31911	429	44130	432	38021
464	33848	459	46523	462	40186
494	35674	489	48762	492	42218
525	37427	520	50879	522	44153
555	39126	550	52901	552	46014
585	40754	580	54828	582	47791
615	42313	610	56663	613	49488
645	43814	640	58419	643	51117
675	45244	670	60099	673	52671
706	46614	701	61701	703	54158
736	47932	731	63229	733	55581
766	49195	761	64691	763	56943
796	50414	791	66085	794	58249
826	51599	821	67413	824	59506
856	52740	851	68688	854	60714
887	53830	882	69917	884	61873
917	54876	912	71108	914	62992
947	55886	942	72257	944	64072
974	56758				
1001	57595				
1028	58406				
1056	59186				
1083	59936				
1110	60656				
1137	61352				
1164	62029				
1191	62682				
1218	63309				
1246	63920				
1273	64514				
1300	65083				
1327	65636				
1354	66176				
1381	66702				
1408	67218				

Table L- 2. Ansell Edmont Sol-Vex Glove - Average GB Permeation

Ansell Edmont Sol-Vex Glove (37-155)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
6	4	9	5	8	5
36	45	39	45	38	45
66	85	69	81	68	83
96	112	99	106	98	109
126	136	129	128	128	132
156	158	159	148	158	153
186	179	189	167	188	173
216	199	219	185	218	192
246	218	249	202	248	210
276	236	279	219	278	228
306	253	309	234	308	243
336	269	339	248	338	259
366	284	369	262	368	273
396	299	399	276	398	287
426	314	429	289	428	301
456	328	459	302	458	315
486	342	489	315	488	328
516	355	519	327	518	341
546	367	549	338	548	353
576	380	579	350	578	365
606	392	609	361	608	376
636	403	639	371	638	387
666	415	669	382	668	398
696	426	699	392	698	409
726	437	729	402	728	419
756	447	759	412	758	430
786	458	789	422	788	440
816	468	819	431	818	450
846	478	849	440	848	459
876	488	879	449	878	469
906	497	909	458	908	478
936	507	939	467	938	487
966	516	969	475	968	496
996	525	999	484	998	504
1026	534	1029	492	1028	513
1056	543	1059	501	1058	522
1086	552	1089	509	1088	531
1116	561	1119	517	1118	539
1146	570	1149	525	1148	548
1176	579	1179	534	1178	556
1206	588	1209	542	1208	565
1236	597	1239	550	1238	573
1266	606	1269	558	1268	582
1296	614	1299	566	1298	590
1326	623	1329	574	1328	598
1356	632	1359	581	1358	606
1386	640	1389	589	1388	614
1416	648	1419	596	1418	622

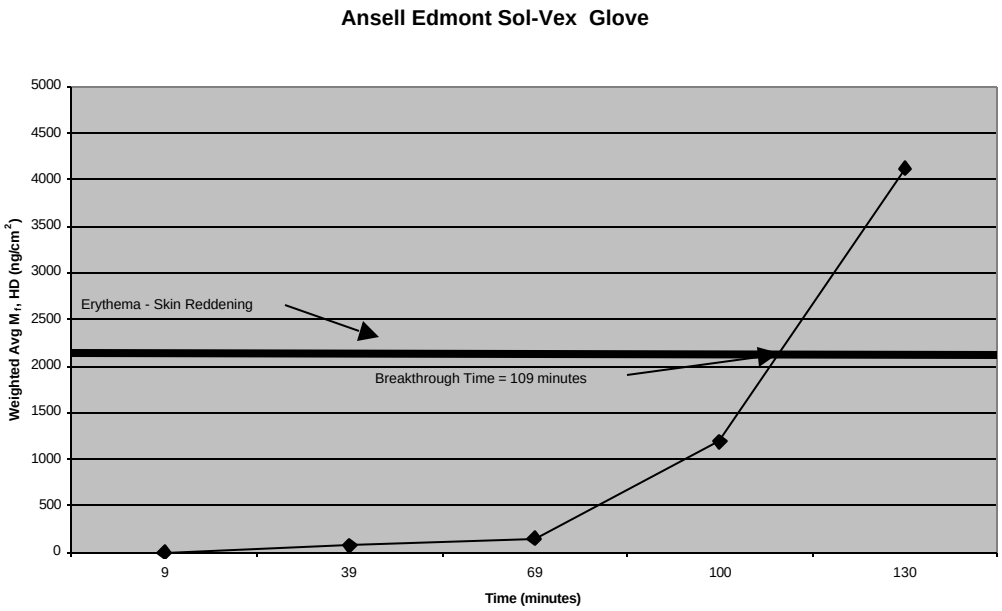

Figure L- 2: Ansell Edmont Sol-Vex Glove - Average HD Cumulative Permeation

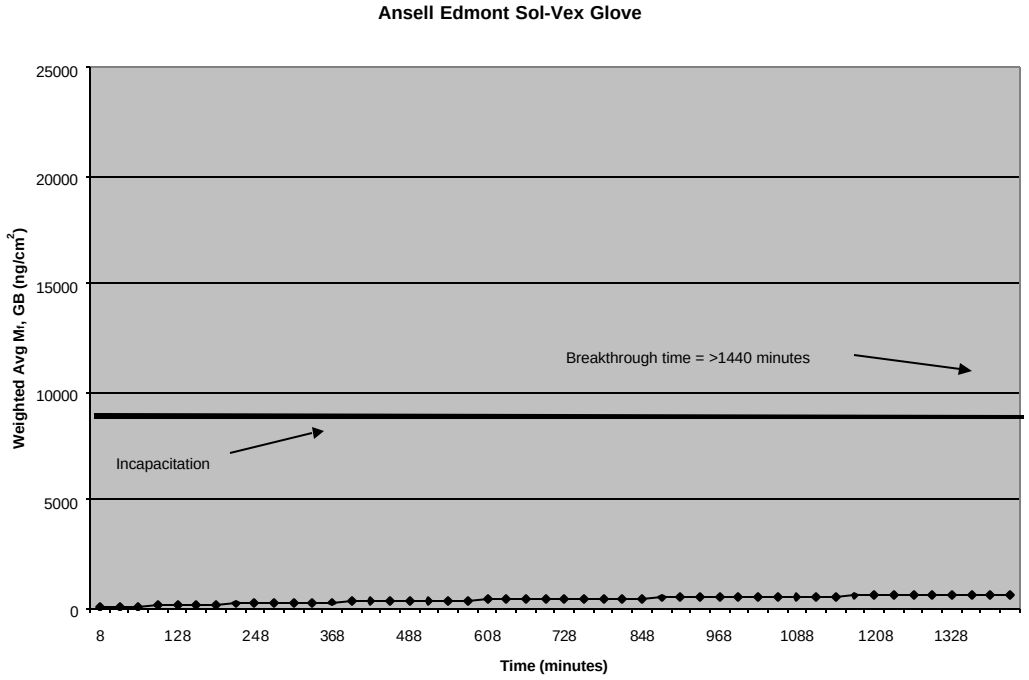

Figure L- 3: Ansell Edmont Sol-Vex Glove - Average GB Cumulative Permeation

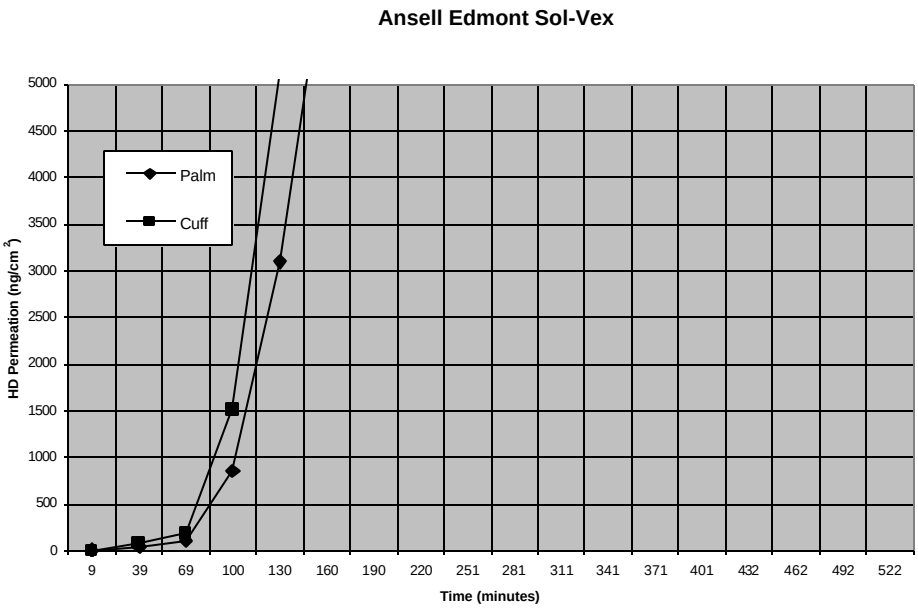

Figure L- 4: Ansell Edmont Sol-Vex Glove: HD Cumulative Permeation by Sampling Area

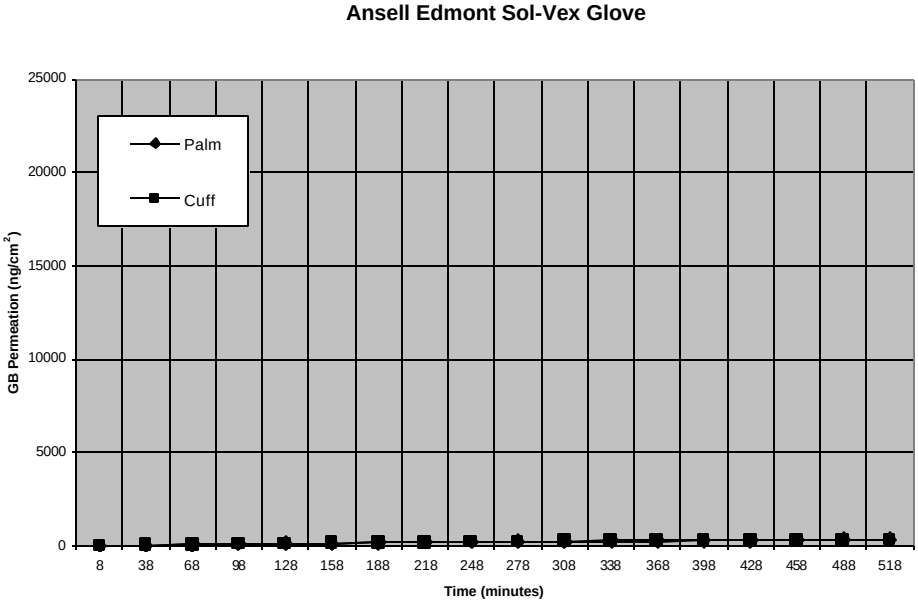

Figure L- 5: Ansell Edmont Sol-Vex Glove: GB Cumulative Permeation by Sampling Area

Appendix M -

BEST VITON

Figure M- 1: Best Viton Glove

Table M- 1. Best Viton Glove - Average HD Permeation

Best Viton Glove (890-10)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
7	6	10	10	9	8
37	37	40	50	39	43
67	47	71	61	69	54
98	60	101	78	99	69
128	82	131	103	129	93
158	118	161	140	159	129
188	169	191	191	190	180
218	234	221	254	220	244
248	312	252	330	250	321
279	399	282	416	280	407
309	494	312	508	310	501
339	597	342	610	340	603
369	707	372	717	371	712
399	825	402	833	401	829
429	951	433	962	431	957
460	1087	463	1103	461	1095
490	1232	493	1254	491	1243
520	1386	523	1415	522	1400
550	1549	553	1585	552	1567
580	1718	583	1765	582	1742
611	1892	614	1951	612	1921
641	2066	644	2140	642	2103
671	2242	674	2335	672	2288
701	2419	704	2534	703	2477
731	2596	734	2736	733	2666
761	2770	764	2938	763	2854
792	2941	795	3140	793	3040
822	3110	825	3342	823	3226
852	3276	855	3544	853	3410
882	3439	885	3746	884	3593
912	3602	915	3950	914	3776
942	3763	945	4154	944	3958
973	3921	976	4356	974	4139
1003	4077	1006	4556	1004	4317
1033	4231	1036	4755	1034	4493
1063	4383	1066	4953	1065	4668
1093	4534	1096	5150	1095	4842
1123	4684	1126	5346	1125	5015
1154	4834	1157	5544	1155	5189
1184	4985	1187	5743	1185	5364
1214	5137	1217	5943	1215	5540
1244	5286	1247	6138	1246	5712
1274	5428	1277	6326	1276	5877
1304	5564	1307	6506	1306	6035
1335	5694	1338	6680	1336	6187
1365	5822	1368	6850	1366	6336
1395	5948	1398	7021	1396	6484
1425	6073	1428	7192	1427	6632

Table M- 2. Best Viton Glove - Average GB Permeation

Best Viton Glove (890-10)					
Time (minutes)	M_f, Palm (ng/cm^2)	Time (minutes)	M_f, Cuff (ng/cm^2)	Average Time (minutes)	Average M_f (ng/cm^2)
4	2	13	2	8	2
34	29	43	16	38	22
64	42	73	26	69	34
94	48	103	32	99	40
124	54	134	36	129	45
155	59	164	40	159	50
185	64	194	44	189	54
215	69	224	48	219	58
245	73	254	51	250	62
275	78	284	54	280	66
305	82	315	58	310	70
336	87	345	61	340	74
366	91	375	64	370	77
396	95	405	66	400	81
426	99	435	69	431	84
456	102	465	72	461	87
486	106	496	74	491	90
517	110	526	77	521	93
547	114	556	79	551	96
577	117	586	81	581	99
607	120	616	84	612	102
637	124	646	86	642	105
667	127	677	88	672	107
698	130	707	90	702	110
728	133	737	92	732	113
758	137	767	94	762	116
788	140	797	96	793	118
818	143	827	99	823	121
848	147	858	101	853	124
879	150	888	103	883	127
909	154	918	105	913	129
939	157	948	107	943	132
969	161	978	109	974	135
999	164	1008	112	1004	138
1029	167	1039	114	1034	140
1060	170	1069	116	1064	143
1090	173	1099	118	1094	146
1120	177	1129	120	1124	148
1150	180	1159	121	1155	151
1180	183	1189	123	1185	153
1210	186	1220	125	1215	155
1241	188	1250	127	1245	158
1271	191	1280	129	1275	160
1301	194	1310	130	1305	162
1331	197	1340	132	1336	165
1361	200	1370	134	1366	167
1391	203	1401	136	1396	170
1422	207	1431	138	1426	172

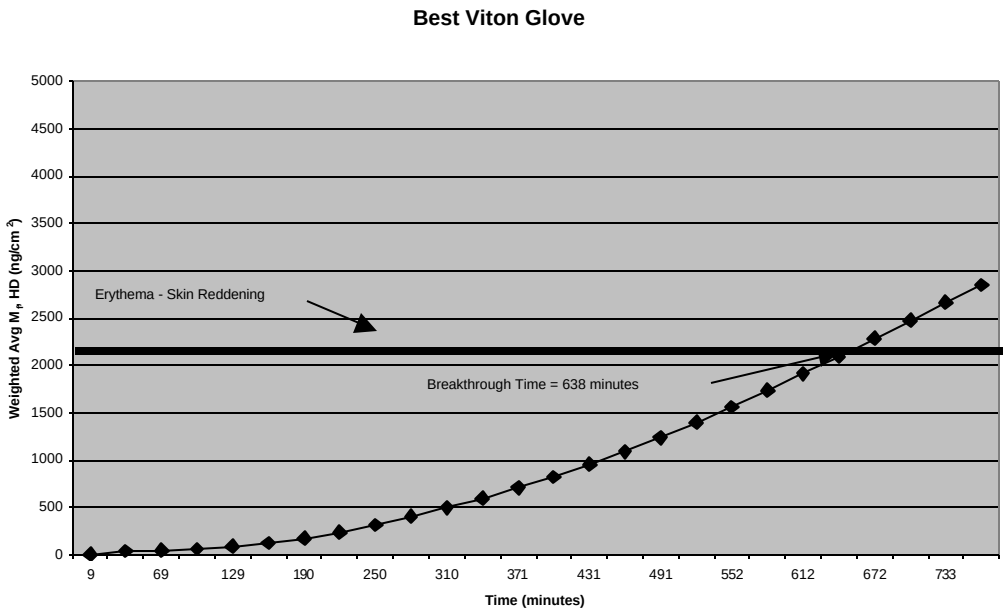

Figure M- 2: Best Viton Glove - Average HD Cumulative Permeation

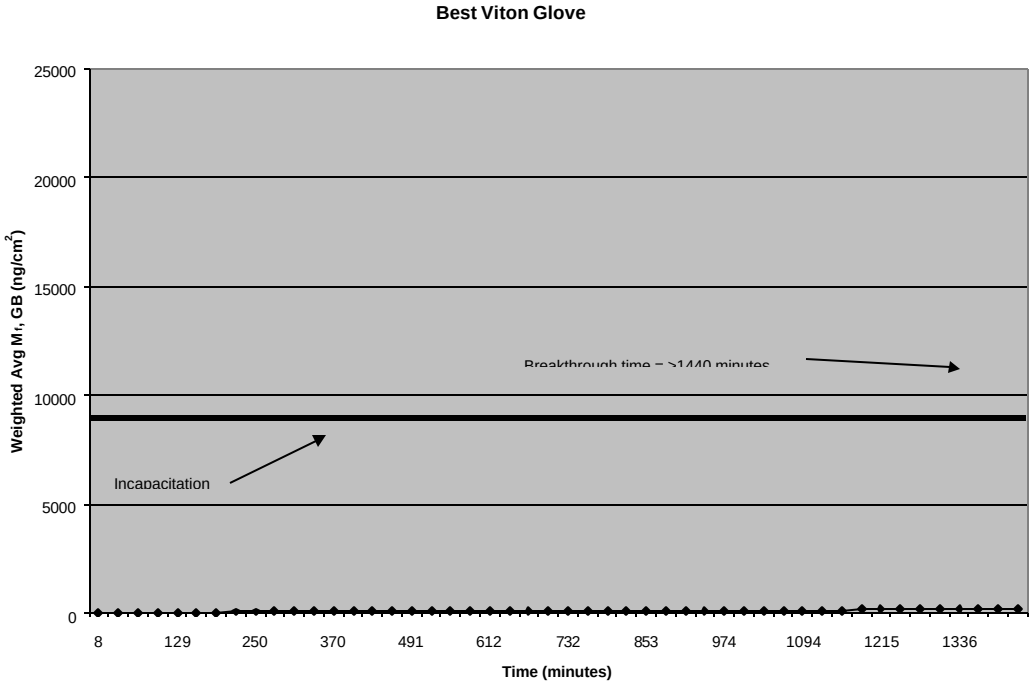

Figure M- 3: Best Viton Glove - Average GB Cumulative Permeation

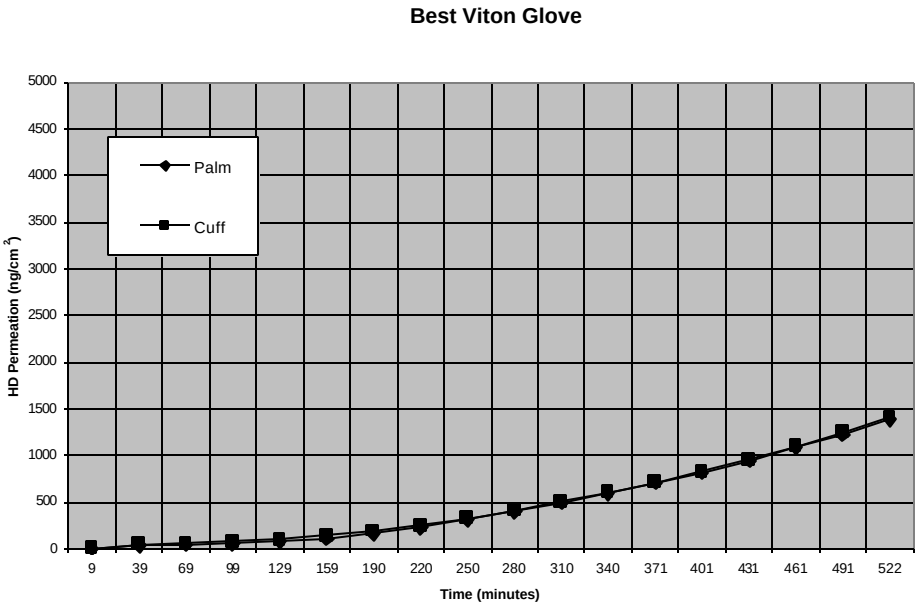

Figure M- 4: Best Viton Glove: HD Cumulative Permeation by Sampling Area

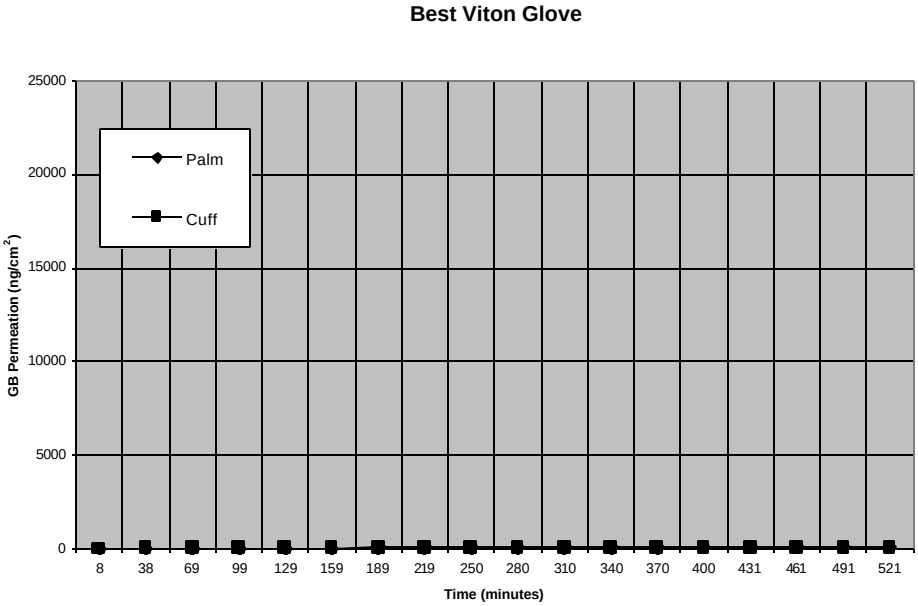

Figure M- 5: Best Viton Glove: GB Cumulative Permeation by Sampling Area

Appendix N -

OVERALL TEST RESULTS

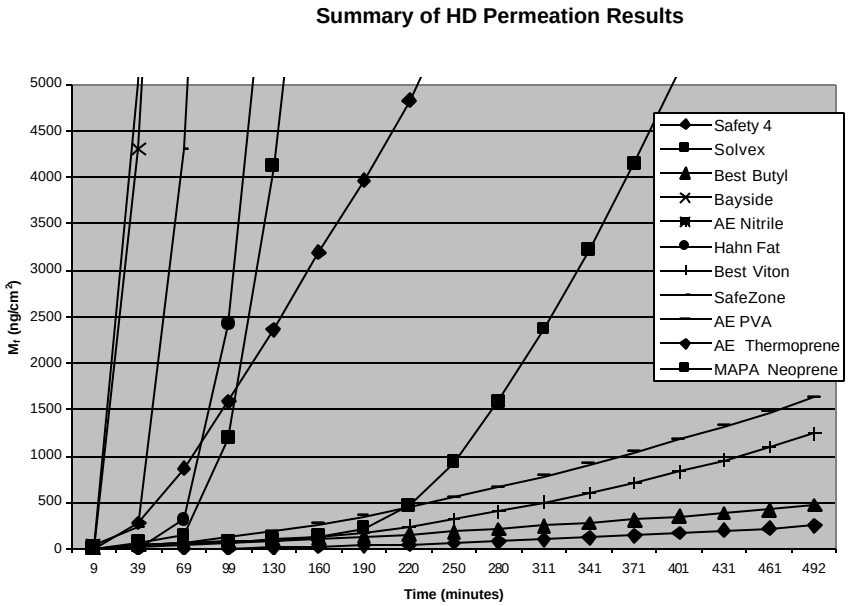

Figure N- 1: Average HD Cumulative Permeation

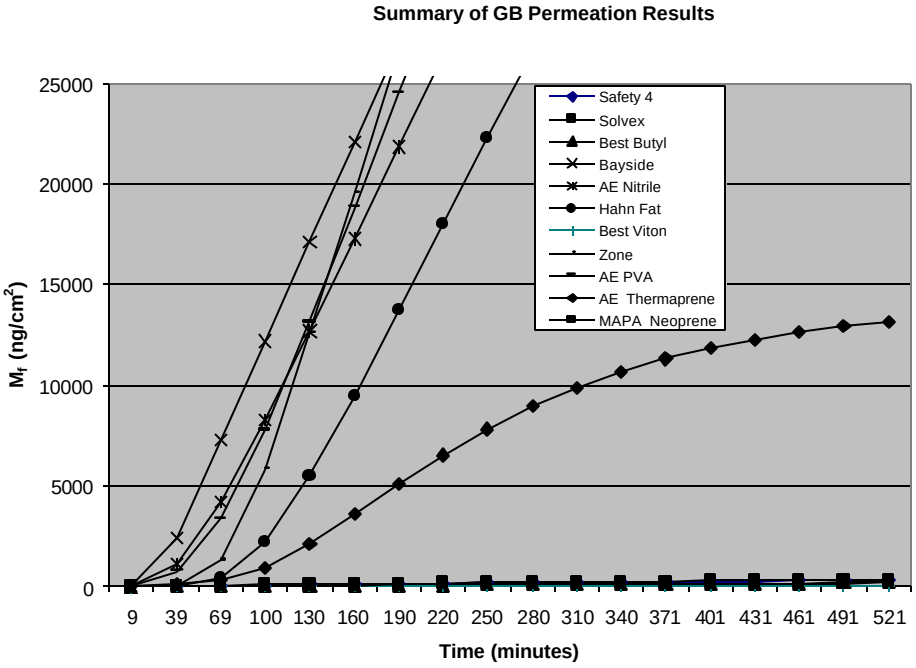

Figure N- 2: Average GB Cumulative Permeation

Table N- 1. Summary of Overall Results for all Gloves

Test Item	Breakthrough Time (minutes)	
	Erythema	Incapacitation
	HD	GB
Best Butyl 878-10, 30 mil	810	>1440
Ansell Edmont Thermaprene, 9-024	119	298
Bayside Latex Examination Glove	23	83
Safety Zone Gloves, GL1-NPFL	54	114
MAPA Neoprene, PN1-N450	298	>1440
Ansell Edmont TNT Nitrile, 92-500	20	106
Ansell Edmont PVA, 15-554	577	110
Hahn Fat, PVC, GL1-VC7714R	97	161
Safety 4H Glove	>1440	>1440
Ansell Edmont Sol-Vex, 37-155	109	>1440
Best Viton 890-10, 30 mil	638	>1440